The Fairchild Singapore Story

1969 - 1987

"Fairchild Singapore Pte Ltd started in 1969. In 1987, it was acquired by National Semiconductor and ceased to exist. The National Semiconductor site at Lower Delta was shutdown and operations were moved to the former Fairchild site at Lorong 3, Toa Payoh. This book is an attempt to weave the hundreds of individual stories from former Fairchild Singapore employees into a coherent whole."

IMPORTANT NOTE

This is a draft.
The final may look significantly different.
Your views are welcome on how we can do better.

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2. Questions to guide the recollection of Fairchild memories

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What this Book is About

"Fairchild Singapore plant together with other multinational corporations in Singapore have allowed the country to move from Third World to First within one generation"

Singapore's first generation of leaders did what was good for the country. Many policies then were bold and visionary and they were subjects of criticisms amongst academics and other politicians but, nevertheless, laid the foundation of Singapore's success. Many of these policies are now emulated in many countries.

One such policy is attracting multinational corporation investments. The government recognised that industrialization promised the most economic progress given the country's lack of natural resources or an agricultural base. The strategic question was whether to reply principally on domestic entrepreneurs or to make a conscious effort to attract foreign multinational corporations that had the financial resources and technology. There were concerns about the damaging impact of multinational corporations on the economic, political and social development of the developing country as they were there not for philanthropic reasons. The government decided to go ahead to encourage the latter in order to reduce the dependence on the Southeast Asia region in general and neighbouring countries in particular.

The country underwent rapid industrialization from the 1960s to the 1980s by attracting technology transfers from the developed world.

Singapore succeeded in assimilating and diffusing technology from foreign multinational corporations that have set foot in the country. This boosted the living standards of many Singaporeans. Today, Singapore's largely corruption-free government, skilled workforce and advanced and efficient infrastructure have continued to attract investments from more than 7,000 multinational corporations from the United States, Japan and Europe.

The Fairchild Singapore plant at Lorong 3, Toa Payoh is one example of the multinational corporation policy. The plant was set up in 1968; three years after the country became independent in 1965. Together with other multinational corporations that established assembly plants in Singapore in the late 1960s, the electronics sector became the country's most important manufacturing element. In the 1980s, Singapore along with Korea, Taiwan and Hong Kong was known as one of Asia's four "little dragons" or newly industrialized economies characterized by an export-oriented economy and trade surpluses with developed countries. In 1988, Singapore's 3,694 manufacturing establishments, employing 352,600 workers, were responsible for 29 percent of the GDP!

This book hopes to capture the stories from the people who have worked at the Fairchild Singapore plant over its almost 20 years' existence until it became National Semiconductor. After the acquisition, most of the Fairchild staff stayed on with the new owner for another almost 20 years before the plant was completely shutdown in 2007. While we attempt to keep the stories in this book within the first 20 years, there are many occasions where they spill into the National Semiconductor era.

Within a generation, the semiconductor assembly and testing industry in Singapore has come and gone -- to places like Malaysia, Thailand and China. This book is an attempt to capture the memories of the Fairchild Singapore plant's "Fairchildren", as former employees of the company are often called. It will serve not just to remind the alumni members of some of the best years of their lives but also to bring to life, at the individual level, one of the more successful government policies that have allowed Singapore to move from "third world to first" within one generation.

Foreword

"We hope to invite Minister Mentor Lee Kuan Yew to pen the foreword."

We are also thinking of inviting current Fairchild President and CEO to pen the foreword.

Acknowledgements

We thank the "Fairchildren" who have taken time off to share memories of their time at the Fairchild Singapore plant. They are grateful for the semiconductor industry training and experience gained there. This is an industry that has treated many of them very well and given them the foundation to venture into other fields.

INTRODUCTION

How Fairchild Singapore Came About

"Recording Fairchild Singapore's history and the manufacturing revolution in Singapore."

Fairchild Semiconductor made its first sale to IBM – an order for transistors at US$150 each. The company was founded in 1957 by eight young employees of Shockley Semiconductor in Mountain View, California. The "*Fairchild Eight*" were Gordon Moore, C. Sheldon Roberts, Eugene Kleiner, Bob Noyce, Victor Grinich, Julius Blank, Jean Hoerni, and Jay Last.

The company spawned manufacturing techniques that reshaped the worldwide semiconductor industry and sowed the seeds of the microelectronics-driven computer industry and personal digital products of today. It became the birthplace of the modern semiconductor industry.

Semiconductors are elements such as germanium or silicon whose electrical properties can be altered by the addition of certain impurities. Products build from these elements – transistors, resistors and capacitors –

can be strung together to build complete electronic circuits. As a class, the products themselves are also called semiconductors or, sometimes, semiconductor devices.

Fairchild Semiconductor was initially funded as a division of Fairchild Camera and Instrument Corporation of Syosset, New York. Bob Noyce, co-founder of the integrated circuit, believed that silicon semiconductors would herald the start of disposable appliances that due to cheap electronic components would not be repaired but disposed when worn out. By 1965, Fairchild's process improvements brought low cost manufacturing to the semiconductor industry. It grew rapidly and was highly profitable. At the peak of its influence, the division controlled over 30 percent of the market for integrated circuits. Sales due to Fairchild Semiconductor had doubled each year and by the mid-1960s comprised two thirds of the total sales of the parent company. By the late 1960s, it reached US 150 million dollars in annual sales and employed some 30,000 people.

Ed Pausa began his career in electronics with Fairchild Semiconductor Corporation in Palo Alto in 1959. He was employee number 454. In 1964, he went to Hong Kong to run the Fairchild Hong Kong plant, the first offshore facility of Fairchild. By the time Fairchild looked at Singapore, National Semiconductor has already started an operation there by about six months. According to Ed, by then, the British has pulled out and Lee Kuan Yew brought in the government, changed all the labor regulations and made Singapore a very attractive place to start an operation.

"Singapore used to have an enormous number of strikes which were aimed at the major employer, the British military establishment. The number of days of work lost due to strikes was very high in Singapore. Ultimately, when the British pulled out, Lee Kuan Yew recognised that they had to do something to improve their economics, so they changed that," said Ed. "The Singapore Economic Development Board was run by a U.N. assignee, I F Tang, and they were very effective in making attractive arrangements. We started out in an auditorium of a school. Later we got land and built a plant in Toa Payoh. We wanted to get started before the plant was ready so we started in a temporary facility."

Ed's experience with Singapore was that the labor force was much more family oriented compared to the labor force in Hong Kong which

was very money motivated. The Singapore workers were more amenable to team activities and relationship building.

Fairchild had been very aggressive in what was called in those days "Jet Age Automation". Fairchild had figured out that with jet aircraft, you were only 12 hours away from Hong Kong and Singapore. At that time, labor rate in America was US$3/hour and Fairchild could get the same job done at 10 US cents/hour in Hong Kong and Singapore. There was a lot of cost to be saved. Fairchild had a pretty labour intensive way of putting things together but they were actually very low cost. Meanwhile, Motorola was automating everything in the Americas. As a result, what Motorola was able to beat Fairchild was not on cost but on superior device characteristics and better logistics.

Fairchild was a real innovator in this offshore strategy in the 60's. Americans copied Fairchild's approach to offshore cheap labour which allows the factories to move quickly with very modest capital investments because you are just using people's fingers to do a lot of the work. The tooling was very low cost and so as technology changed, you could tool something else and move on. It was the seed of success of the US industry over the next ten years. Later the disk drive industry did exactly the same thing.

It was also the seeds of problems that the industry got into later because the Japanese decided to automate. But things were changing so fast that by the time they had automated something, they had done it for the last generation.

Ed left for National Semiconductor in 1969. "The very last thing I did for Fairchild was to negotiate, organize and getting the Singapore plant started for Fairchild," said Ed. "We started in a school. We had the assembly lineup on the stage block of the school."

In April 1969, Fairchild Singapore Pte Ltd was established as a subsidiary of Fairchild Camera & Instrument Corporation (USA). The factory was built at Lorong 3 Toa Payoh to assemble integrated circuits. The investment was 4 million dollars. Starting with 400 employees, it was one of the few factories in Singapore that worked around the clock with three shifts. Capacity was 300,000 ceramic packages a week. The finished products were sent to the Mountain View, California for testing.

Six years later, in 1975, a second factory was built with an additional fixed investment of more than 9 million dollars adding final testing and finishing operations.

"This brings to Singapore more sophisticated technology, a greater investment per worker and a higher degree of skills and engineering," declared Mr Hon Sui Sen, the Minister for Finance who was the guest of honour at the official opening of factory two. In a recruitment advertisement in the Straits Times in 1980, Fairchild Singapore declared itself to be the largest Test and Finish Facility in the world.

In 1987, National Semiconductor acquired Fairchild. The acquisition included the Singapore plant as well as plants in Cebu, Philippines; Korea and Nagasaki, Japan. By then, Ed was the Corporate Vice President of International Manufacturing and Services. Three years later, Ed retired from National Semiconductor.

CHAPTER 1

The Managing Directors

"It was Bill Watson who promoted me to become the MD's secretary."
Betty Ho
Fairchild/National Semiconductor 1970 to 2006

Betty Ho worked in Fairchild/National Semiconductor for 36 years. Her badge number was 168. During those years, she served as the secretary to ten out of the eleven Managing Directors (MDs) that Fairchild/National Semiconductor Singapore Plant had. Betty started in February 1970 as a secretary in the Finance Department working for William (Bill) Watson, the Finance Controller.

Arthur B. Francis (MD 1969 – 1972)

Arthur B. Francis was the first MD of Fairchild Singapore from 1969 to 1972. "At that time, most of the expat contracts were 2 years with extensions to 4 years," said Betty. Arthur joined Fairchild in 1966 and worked for a year in Mountain View California before being transferred to Hong Kong. With his experience in Hong Kong, Arthur was asked to head

the operations in Singapore. He left Fairchild Singapore in 1979 and went back to Hong Kong to run his family business.

Bill Watson (MD 1972 – 1973)

Bill Watson was promoted to take over Arthur when he left. "He was the one who promoted me to become the MD's secretary. "Potong jalan" – I call it as by seniority, it should have been Elizabeth, the lady who worked for Don Spurling, the engineering services manager," recalled Betty.

Bill Watson (far right), hosting Wilf Corrigan, who was General Manager of the Fairchild Semiconductor Division. Wilf later became the President & CEO in 1974 and Chairman in 1977. On his right is Bill's Japanese Wife. Chuck Smith (far left) was the General Manager for Fairchild Asia. Circa 1973
(Photo Courtesy of S S Leong)

During Bill's tenure as MD, there was a strike at the factory. Eventually, Bill left Fairchild Singapore in 1973 and went to Japan. He had a Japanese wife and one daughter.

Bill was a brilliant man and could speak several foreign languages including Russian. "He could read a book in one night," recalled Fred Stillger. He also loved to party and sometimes would not go home and then call his wife in the morning to bring in his toothbrush and razor. "He was not a technical person and would depend on me for any technical matters," recalled Fred Stillger.

Chris Reardon (MD 1973 – 1976)

Bill served from 1972 to 1973 and Chris Reardon took over serving for another 4 years till 1976. Helen Phang from Finance, joined Fairchild on 20 November 1975 when Chris Reardon was the MD. "On a sunny day, when Chris Reardon walks past the corridor, he would say 'put on your bathing suit'," recalls Helen fondly. She has worked in Fairchild/National Semiconductor for 28 years.

Chris Reardon joined Fairchild in 1964 as manufacturing manager for Australia. In 1969, he was transferred to Seoul, Korea as engineering manager. In 1971, he took over the Fairchild Hong Kong operations as General Manager. In 1973, he was transferred to Singapore and took over as Managing Director. He expanded the operations from 45,000 square feet to 92,000 square feet with the opening of Factory Two. The workforce increased from 1,250 to 3,500 with the addition of the test operations. "We designed Factory Two around the process and it was the first time in the history of the industry that a factory was designed specifically around a process," recalled Chris.

During Chris' last year in Singapore, he had added responsibility for Southeast Asia, which included Indonesia and a subcontractor in the Philippines. At that time, Indonesia shipped products to Singapore for test and finish. One time Chris was taking a turkey to the expats in Indonesia and he was stopped at the Indonesian customs. He was asked what he was going to do with the turkey and he told them he was going to have a barbeque for his Indonesian friends. Another time, Chris had to hand carry

gold wire for the Indonesian plant. When customs asked him what it was, he told them the truth. They did not believe him and again let him through.

"Chris was a very personable individual and was well liked," recalled Fred Stillger. A Welshman by birth, he was married to Dorothy, an Australian and had three children. One of his sons is called Danny as Chris loved to party and loved to sing "Danny Boy". At work, he delegated well and was a good salesman for Singapore and Fairchild. He had a good relationship with the local government officials. He liked to argue with his boss, Chuck Smith though. He liked to lunch at the Tanglin Club having a glass of wine, steak and kidney pie.

Chris left Singapore in 1976 and returned to US. He left Fairchild shortly in 1977. He passed away a couple of years ago in Australia.

Fred Stillger (MD 1976 - 1977)

When Chris became the Group Managing Director responsible for the Indonesia and Singapore Plants, Fred Stillger, the operations manager, took over serving for two years. As MD, Fred got more involved in external matters and was a member of the American Chamber of Commerce, serving on several committees. "I remembered that Betty Ho was very knowledgeable about the plant operations and was able to draft answers to correspondence from the US," said Fred. With the operation of the new Test and Finish plant in Factory Two, Fred spent more time in the area of logistics and shipping. A shipping line was set up on the factory floor where parts were able to ship direct to customers instead of having to go to the store. This was the time when Information Technology (IT) began to drive operations. Computers were just taking over the fax machines. "I actually attended a class by IBM Singapore on the operation of computers and how they are programmed," said Fred. The IT Department was so efficient that they actually wrote programmes which expedited the lay off process. Those laid off were all recalled back to work a few months later as business picked up and they were needed in other areas of work.

Bruce A. Stromstad (MD 1977 – 1979)

Bruce Stromstad took over in 1977. Bruce served for only two and a half years. Betty Ho was the admin assistant to the MD. "Betty and I share the same birthday, April 23 and since then we have been sharing birthday greetings," said Bruce who is now based in Thailand as the General Manager for Hana Semiconductor. "He was strict and did a great job by firing John Lye as Personnel Director," recalled Betty.

Bruce graduated from the University of Wisconsin with a degree in Electrical Engineering on 21 January 1967. He started work at Fairchild San Rafael nine days later. His first expatriate assignment was in July 1973 where he was sent to Fairchild Hong Kong as the Operations Manager for the Diode line. The plant manager at that time was Dick Martin and later Dick Belcher.

In January 1975, Bruce moved to Korea to take over the K-1 factory as Plant Manager. The other factory in Korea at that time, K-2 was managed by C C Kim. Both gentlemen reported to Hank Mahler, the Country Manager for Fairchild Korea. It was in Korea that Bruce met Yoon, his wife of 36 years.

Because of his experience in Hong Kong and Korea, Bruce was quoted in a Straits Times article, "Singapore workers' output through the eyes of multinationals (2 October 1979)," that the South Korean worker was ten per cent more productive than either the Singapore or Hong Kong worker who in turn are ten per cent more productive than the average Indonesian worker. Fairchild tested productivity by measuring the number of labour hours taken to produce 1,000 integrated circuits. As it had four plants in Asia, comparisons could be made.

In Bruce's view, this was due to differences in work attitudes. He gave an example: If a female Korean worker is told to produce 150 parts a day, she will ensure that it is done. If her machine breaks down, she will work through the lunch hour. "The Korean worker tends to be more innovative, more thinking," he added. "She will find short cuts to accelerate production. The Singapore worker will do as she is told and no more." In part, the attitude of the Korean may be wholly influenced by the need to find work in an oversupply situation. The Korean evidently feels lucky to have landed a job and will persevere to hold on to it. "Supervisors,"

said Bruce, "are the key to factory output … they are the frontline managers."

Bruce completed his term in Singapore and moved to South Portland, Maine where he worked for a year as Operations Manager. "We did not enjoy living in Maine so I requested a transfer back to California where I ended up in San Rafael for the second time in my career," said Bruce. He left Fairchild in 1982 to return to Asia as the General Manager for Signetics Thailand.

Bruce met friends inside and outside of Fairchild while living in Singapore that he still stayed in touch with today. For example, Bruce recalled how Lawrence Lee helped him out of a mess up involving his daughter and her cousin in 1998. Bruce decided to fly his 16-year-old daughter, Stephanie and her cousin over to Singapore to join him on his business trip. But he got the dates mixed up and he was still in Taiwan visiting Siliconware when he realised these children would arrive in Singapore two days before him and they had no money and no hotel. "In a panic, I called Lawrence and he told me not to worry," recalled Bruce. Lawrence then met my daughter and her cousin at the airport, put them up in a hotel and had his daughter take care of them for two days before I arrived for the rest of my trip.

Harry Van Wickle (MD 1979 – 1981)

After Bruce was Harry Van Wickle. Harry was the Vice President of Asia Operations from 1978 to 1983. He served as MD of the Singapore for 4 years. He was previously Fairchild Singapore's operations manager as well as regional quality manager.

Don Brettner (MD 1981 – 1983)

Meanwhile, Don Brettner's wife heard about Singapore from Bruce's wife. They wanted to be in Singapore and so Don took over the MD's job. He stayed only for one and a half years as most of the directors were not happy with him and threatened to leave. So Don was relocated back to USA.

Mike Morrissette (MD 1983 – 1986)

Mike Morrissette stayed for a good four years as MD, from 1983 to 1986 before a local MD took over. "Mike is nice and I do enjoy working for him," said Betty fondly. Mike was responsible for Fairchild's Southeast Asia Manufacturing Operations. In 1989, he joined Western Digital Corporation to start up their first disk drive manufacturing operations in Singapore.

Mike Morrissette joined Fairchild Semiconductor in June 1962 in South Portland, Maine. The company was in the early preparations to install assembly operations and was temporarily housed in a leased building which had previously been a car sales operation. Mike was the seventh person hired at this facility which consisted of five operators in training, an electronics technician and him. There was a temporary plant manager from California who was eventually replaced by Ed Pausa.

Mike first came to Singapore in 1972 to support some new process equipment transfer and stayed for six weeks during that transfer. "I was quite impressed with Singapore, the spirit of the country, as well as that of Toa Payoh employees – very friendly and with a 'Lets get it done' attitude," said Mike. He made countless trips to Singapore from then on, mostly in his capacity as Planning Manager of the digital products for South Portland. "My enthusiasm for the Singapore operations never waned and I was always an eager supporter in any way I could help," said Mike. "Often, my role was acting as an interface between the US and Singapore operations making both sides understand the problem at hand and how best to resolve it – neutralizing politics is probably a good description."

Tan Bock Seng (MD 1986 – 1993)

The local MD who took over Mike was Tan Bock Seng, from TI Singapore where he spent 18 years. He stayed as MD for 8 years, from 1986 to 1993. "He was one of the best MD's I have worked for. He is a stern and no-nonsense MD but very fair from my point of view," assessed Betty.

Wan Choong Hoe took over for about 9 years before handing over to the last one, Gary Chua, who spent less than a year on the job before the plant was closed. Betty said, "He was there to close the plant. I worked for him for only 3 months before I was granted retrenchment. Irene Ng took over my job."

CHAPTER 2

Official Opening 1969

"Dr. Toh Chin Chye, Minister for Science and Technology, officially opened the plant on 4 December 1969"

The Straits Times had a two page supplement on the official opening of Fairchild Singapore on 4 December 1969 by then Minister for Science and Technology, Dr. Toh Chin Chye. It was attended by Joe Van Poppelen, Vice President and General Manager of Fairchild Semiconductor Division as well as Gene Blanchette, Manager of the integrated circuit operations in the USA.

The factory had already started operations in April with 400 employees at a temporary site. By the time of the official opening, there were 800 employees. The temporary site was the upper floor of HDB's Toa Payoh Estate west office. Toa Payoh was the first prototype town centre in Singapore. It was a notorious squatter district until the early 1960s when the squatters moved out and clearing work was able to commence. "There was nothing at Lorong 3 in 1968," said S S Leong. "Absolutely nothing. We were using the upper floor of the HDB's Toa Payoh Estate West Office located at Lorong 2 while the Lorong 3 Fairchild building was being built. A furnace was hauled up the second floor and there was one line set up for assembly of ceramic DIPs."

Toa Payoh in 1967. Fairchild Singapore is at the top right hand corner.

The Government also helped to recruit production workers, mostly girls aged between 16 and 20. Before going into the factory, they go through a week-long industrial orientation course at the National Productivity Centre at Jurong. Unlike in Hong Kong, the Singapore girls are generally English-speaking, which for Fairchild, makes training, supervision and quality control easier.

Running the Fairchild plant was a tip-top team with technological expertise and business acumen, The Straits Times reported.

The Managing Director was Arthur Francis who was an MSc physics graduate from the University of California at Berkeley. Supporting him in engineering services was Donald Spurling. He worked in Fairchild South Portland, Maine four years before coming to Singapore. Prior to that, he spent 15 years in microwave tubes and another seven years in semiconductors. He was a graduate in electrical engineering from MIT.

Arthur Francis was quoted in the Straits Times (14 May 1969) as describing Fairchild's expansion in Singapore as "a matter of logic". It is not only a question of stable labour. Fairchild is mindful of a growing market for semiconductors in the East. For example, Fairchild Hong Kong was shipping components to Universal Electronics, Singapore's first transistor radio assembly plant that had just been set up by entrepreneurs from Hong Kong.

The manufacturing manager was Raymond G. Wollesen, a seasoned veteran with Fairchild. He has been with the company for ten years. He started his career with Fairchild in quality control. Since then, he has moved to other positions of responsibility in marketing, engineering and processing. Before coming to Singapore, he was with Fairchild's Mountain View plant.

William G. Watson was the Finance Controller. He has been with Fairchild for three years serving as Finance Controller in Mountain View and other plants in the United States. He was formerly with Ford Motors in Michigan as an executive in the economics department. He holds a BSc in economics and an MBA in accounting and econometrics from the University of Chicago.

K W Sin, from Fairchild Hong Kong plant, was the Quality and Reliability Manager. He has been with Fairchild for six years. A graduate in electrical engineering from Taiwan University, K W Sin worked for three years in a Hong Kong TV Station before joining Fairchild. He married Rosie, one of the MD's secretary.

The only local man in the management team was K S Lim. He took charge of the handling of traffic, personnel and cargo. Before joining Fairchild he was senior traffic officer of the Port of Singapore Authority for nine years. Prior to that, he was a teacher for eight years.

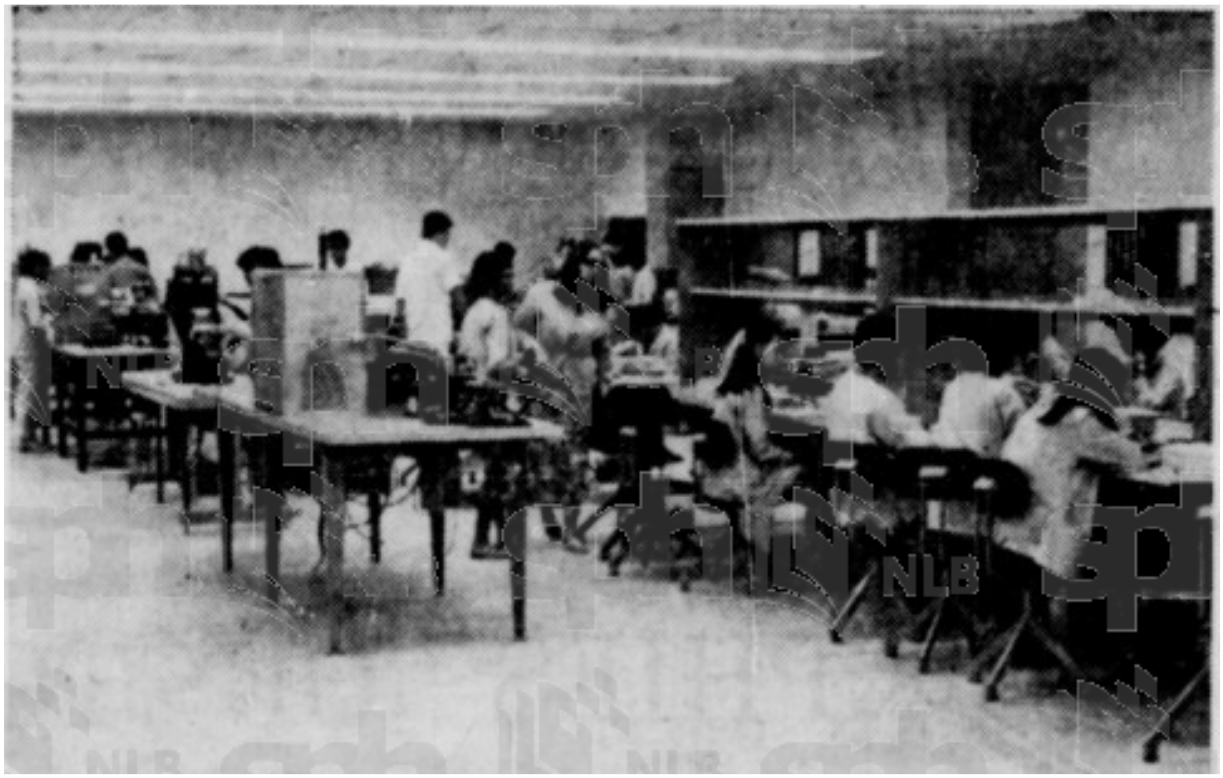
All the production workers were females. Because of delicate handling of component parts and the need for patience on the production lines, women were preferred. The minimum qualification is a secondary two certificate.

Technicians were of three categories – mechanical, electrical and electronics. They have qualifications from the polytechnic, a trade school or City and Guilds.

There were different section heads in charge of plant maintenance, line maintenance, machine shop, purchasing office, financial accounting and quality control. These have university or polytechnic qualifications.

Fairchild Singapore Pte Ltd, 1969
(Source: The Straits Times, 4 December 1969)

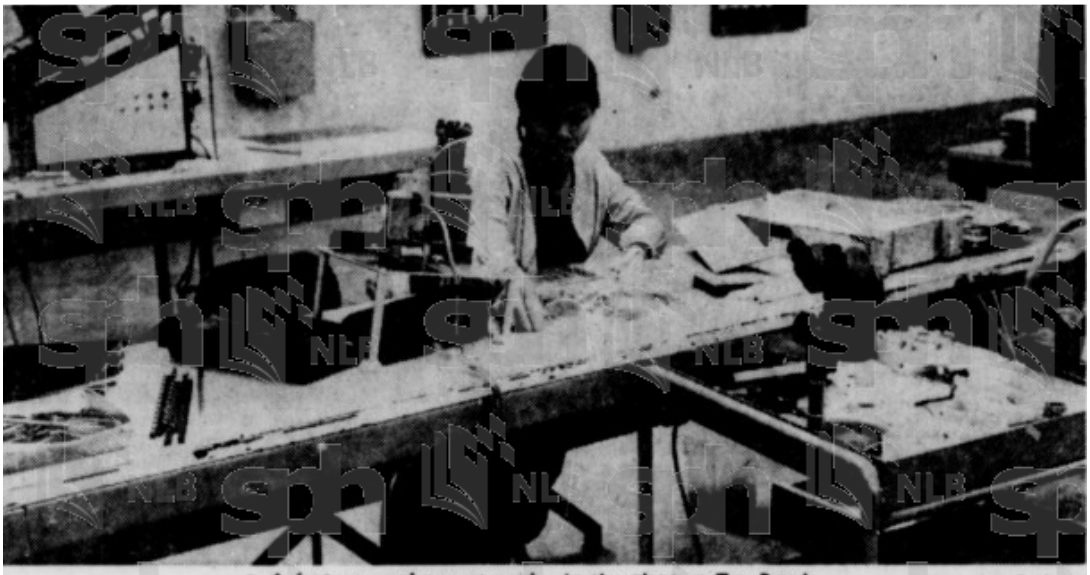
The factory was described as an ultra-modern two-storey building. Its administration offices and the assembly line were on the first floor while the workshop, canteen dispensary and other amenities were on the ground floor. The plant was completely air-conditioned with special humidity control to prevent moisture from getting into the products. To ensure that air-conditioning did not break down, the building had two plants.



CDIP Frame Attach Operations

The products from the factory were used in computers, calculators and TVs. They comprise a small one-inch wide leadframe on which is mounted a circuit die. This die is connected to the 14 "teeth" of the leadframe via very fine aluminium wire which is sandwiched at the top and bottom by two pieces of ceramics. All components were manufactured in the United States and shipped to the Singapore plant for assembly.

The official opening was on 4 December 1969 with Dr. Toh Chin Chye as the guest of honour. The factory featured female only production workers due to the delicate shop floor operations.



A factory employee at work in the plant at Toa Payoh.

"I was one of the six Singaporeans who were sent to Fairchild Hong Kong for training," said S S Leong, who joined the company on 17 March 1969. "The graveyard shift was started in 1970," recalled S S Leong who was in manufacturing. "We were all very young and full of life. We had many picnics with the female operators. We had great Annual Dinner & Dance events."

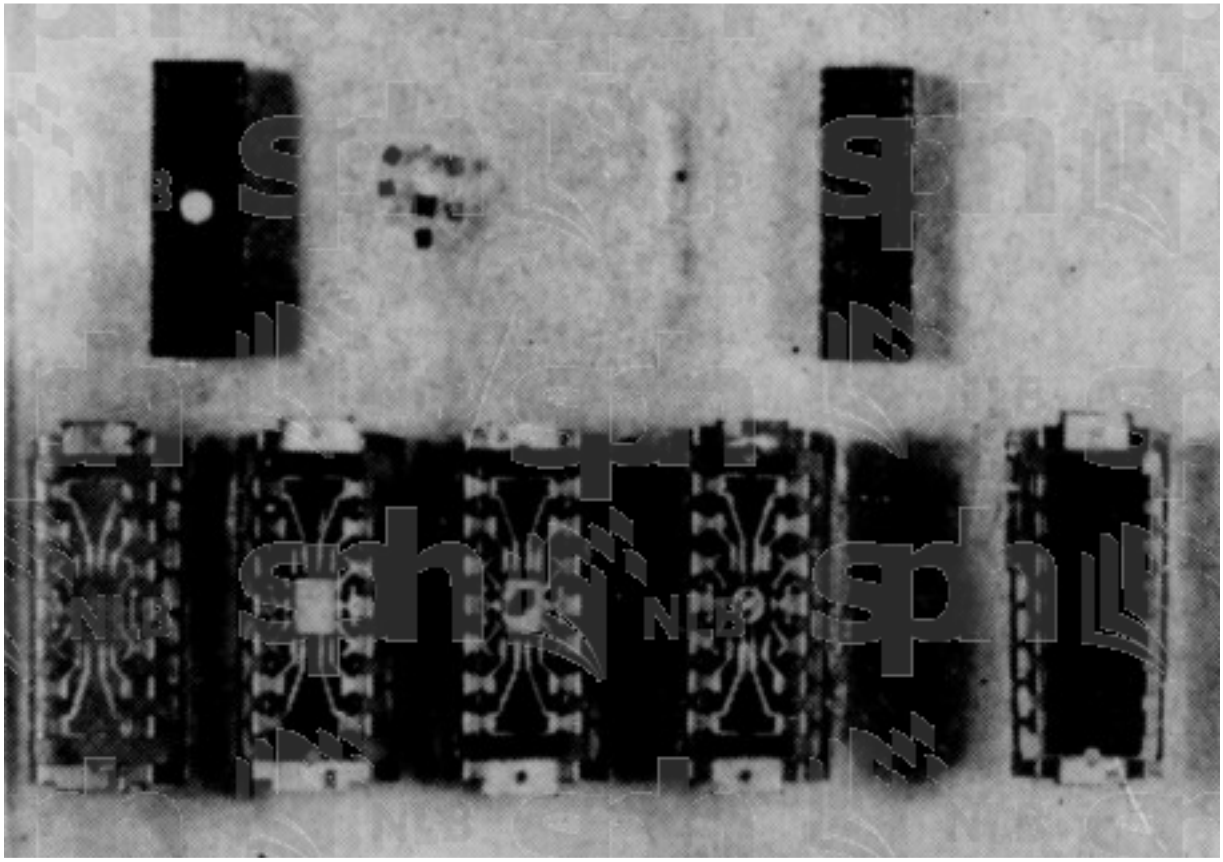
The other Singaporeans who went to Hong Kong were Willie Chan responsible for facilities, K S Lim for personnel, K S Lau for maintenance, K W Yao for quality (reporting to K W Sin), and T Y Leo for manufacturing.

S S Leong joined Fairchild Singapore on 17 March 1969. "I remembered because it was my daughter's birthday," said S S Leong. A graduate from United Kingdom, S S Leong spent 5 years working for the Singapore Broadcasting Corporation before joining Fairchild. "I saw the advertisement in the papers and applied for the job. I did not want to stay in the civil service. Electronics was the new frontier. My starting pay was $1,200 per month," recalled S S Leong who was 29 years old when he joined the company.

One of the supervisors S S Leong hired in 1969 was Murphy Teo. "I still remembered the interview," recalled Murphy. "He asked me: 'How can you make sure your operators work hard?' I answered: 'Stand behind them

and watch." With that, Murphy was hired to run the ceramic packages assembly lines.

Because of the complexity of the assembly functions, highly specialised equipment was used. All the machinery and equipment were brought in from America. "The techniques applied in assembling the products are among the most advanced in the world," claimed Arther Francis, the MD.



"In the ceramic wire bonding operation, we had one operator per machine," said Murphy. "Each machine was making 60 hits a minute. Seven years later, we had one operator managing eight machines with each machine making 500 hits per minute," commented Murphy on the rapid increase in productivity at that time. "Technology was changing so fast. If the changes in the car industry were at the same pace, the car would cost about that of a bicycle today."

In 1971, S S Leong left the CDIP line to set up the Plastic DIP line in Singapore. There were no local suppliers so all the materials came from the United States. There were about 3,000 operators in the CDIP line and about 2,000 operators were hired for the PDIP line.

In 1972 when the Fairchild Sales department was started, S S Leong left manufacturing to join sales and stayed there for seven years before leaving in 1979 to start his own business.

Meanwhile, Murphy Teo stayed on in various capacities in the Ceramic, Plastic, Testing and Backend Operations. In between, he also had the chance to work in Fairchild Indonesia for a year. It was in the Materials and Logistics Operations that Murphy stayed the longest as the Materials Director.

Ray Wollesen in the Plastic Assembly operations promoted H W Hong and Patrick Ngo to Superintendents. The other Superintendents were King Beng Wah and B E Tan.

From Superintendents, Murphy Teo and H W Hong were promoted by John Chan to be Assistant Production Managers in the Ceramic and Plastic Assembly operations respectively. S K Yeo was one of the Superintendents who reported to H W Hong.

Murphy worked for all the Managing Directors from Arthur to Tan Bock Seng. "The best MDs to work for were Harry Van Wickle and Mike Morrissette," said Murphy.

In the early 70's, many of the production supervisors hired were formerly teachers, especially the technical teachers. They were attracted by the bigger pay package offered by electronic factories like Fairchild – nearly double what they were earning as non-graduate teachers. For example, as technical teachers, their starting pay was $190 per month with annual increments of $10. As production supervisors, the starting pay was $560 per month. If they had remained as technical teachers, it would require more than 30 years of service to reach this amount after crossing probationary and efficiency bars. Life as production supervisors was not a piece of cake. They soon found out that they were not only responsible for supervising and coordinating production schedules, they had to tolerate truancy and uncooperative female production workers as well as torments from their superiors. To keep production up, they had to organize outings for the operators and treat them well. Eventually a few rejoined the

teaching service. Those who stayed, like Philip Low and Tan Bock Seng, rose to become Managing Directors, Philip Low for Printronix and Tan Bock Seng for Fairchild Singapore.

K C Lau joined Fairchild Singapore in 1972 reporting to Stanley Tan. He is one of the many Malaysian Chinese who went to Taiwan for his degree in Electrical and Electronics Engineering. As a result, he has limitations with his English.

K C Lau started process engineering in PDIP handling the manual bonders which were known as "Butterfly". One of the problems with the gold ball bonds from the manual bonders was lifted bond. Occasionally, the operator did not press down hard enough for the ball bond to be formed. To solve this problem, K C Lau introduced weights to be added to the bonders so that the operators have better control of the bonding process. Later the bonders were converted to semi-automatic K&S bonders and eventually fully automatic Shinkawa UTC bonders.

Process engineering at that time had to also help the quality group to set up the de-cap process for PDIP for failure analysis. The plastic package was first subjected to grinding to remove some of the plastic material before foaming nitric acid was used to etch the thermoset plastic to expose the die.

There was also a problem with mold flash that affected the plating process. Dr Chan was hired by K C Lau to develop a chemical to remove the flash. "I was the first to hire a PhD. At that time no one else dared," recalled K C Lau.

When the MOS 40 leads PDIP clock chip 3817 was transferred to S2, there was problem with the Disco Saw machines. Peter Kwan in Equipment Maintenance and Don Mamayek could not get the equipment running. K C Lau was transferred to S2 reporting to Philip Low, the Business Manager, to resolve this and get the saw process going. "There was also a lot of fight with product engineering as they thought that the wafers were corroded due to the discolouration," recalled K C Lau, who was then the Process and Equipment Maintenance Manager. He was able to prove to them that the discolouration was not corrosion but was due to uneven wafer coating. When incident light was reflected on the wafer, rainbow colours were exhibited leading to the product engineers thinking that it was corrosion. To prevent corrosion, DI water was set up.

K C Lau also flew to Japan to buy off the molds as it was difficult to shoot the mold compound causing mold short due to the deep molds required for the 40 leads package.

While at S2, K C Lau also remembered the setting up of the Beta project by Joe Koh and team. "Dax Kwoh was hired to go to USA to be trained on this product," recalled K C Lau. He was a technician from TI Singapore and after the US stint, he returned to Singapore and became the Engineering Manager.

When the Ceramic Operations had oxidation problem on the gold base, K C Lau was transferred back to Toa Payoh to solve the problem. He reported to C E Tan who was then the Engineering Manager. To resolve the problem, K C Lau recommended the conversion from golf base to platinum plus. In order to allow the platinum plus to wet properly at high heat, a nitrogen shroud was introduced.

Another problem was hermetic leakage problem detected at gross leak test. This was due to the solder sealing of gold lids on LCC packages using the same furnace with the ceramic packages which were glass sealed. The ambient in the furnace was somehow contaminated by the solder sealing process. To solve this problem, a separate furnace was introduced for the solder sealing of the gold lids.

K C Lau also remembered the good old days when he was sent to Jakarta to help set up the processes for products transferred from Singapore. He left Fairchild Singapore in 1986 and joined Conner Peripherals.

CHAPTER 3

1972 – 1977: Fred Stillger's Leadership

"In 1972, the Plastic DIP wire bonders were Z-Stick Bonders manufactured by Fairchild."

On 8 May 1972, Fred Stillger stepped out of the plane at the Paya Lebar Airport feeling the hot humid air rushed to his face. "There was no gangway and we stepped right onto the tarmac," recalled Fred vividly. It was his first trip to Singapore. Fred had previously been to Fairchild Hong Kong and Korea where he met Chuck Smith, the Fairchild Manager of the Far East Operations. Chuck subsequently met Fred in Mountain View and offered him a job in Fairchild Singapore as Engineering Manager reporting to Bill Watson.

Bill Watson, the Managing Director of Fairchild Singapore in 1972, met Fred at the airport and brought him and his family to the Hyatt Hotel. "We could have dinner for three at Hugo's, the best Hyatt restaurant, for US$30 including wine and desert!" said Fred.

Fred joined Fairchild Mountain View in 1969. Prior to that, he worked in engineering positions in Motorola and National Semiconductor.

A graduate from Creighton University in Omaha, Nevada, Fred spent 5 years as a US Air Force officer.

When Fred started work at Fairchild Singapore in 1972, Joe Shagday had been recently assigned as Production Manager replacing Ray Wolleson who left to become AMD's Penang Plant Manager. As a result, Fred inherited Ray's secretary, Lim Soo Koon. She subsequently left to marry Ray. Other members of Fred's team included C E Tan, the Hermetic Engineering Manager and Stanley Tan, the Plastic DIP Engineering Manager. Tan Bian Ee was the Training Manager. He later left and eventually became the VP of Asia Operations for HP.

The Straits Times reported the two-day visit to Singapore by Dr. C. Lexter Hogan, President of Fairchild Semiconductor Corporation on 10 August 1972. Dr Hogan was on the last leg of his Asia tour which included Japan, Korea, Taiwan, and Hong Kong. While in Singapore, Dr Hogan was reported to have said, "In the next five to seven years, the worldwide market for semiconductor products will increase three-fold from US$9 billion. Production facilities and the number of workers will therefore have to increase to meet the demand. Singapore Government's emphasis on quality and the upgrading of the level of technology of the workers is far-sighted."

The Industrial Engineering Department was established by Fred Stillger. He hired Sam Lim, a new college graduate, as an Industrial Engineer to set scientific labour standards and prepare factory re-layouts to improve process flows. He was also involved in the transfer of the Ceramic DIP piece parts line from South Portland, Maine to Singapore. "When I interviewed Sam, I asked him what his ambition was and he said, 'If I was a shoe shine boy, I will be the best in the street. I aim to be the best Industrial Engineer.' I immediately hired him," recalled Fred. Sam did well and became a manager two years later. Sam later left and formed his own company and is now the Executive Chairman and CEO of Sunright Singapore, a burn-in and test services provider.

Chris Reardon took over from Bill Watson as MD in 1973 and hired Johnny Hyde from Australia to manage the construction of Factory Two. It was being constructed on the lot next to the main building which used to be the football field. Factory Two was officially opened in 1975. That was also the year where the semiconductor industry witnessed the worst

recession. Fairchild Semiconductor was reported to be one of the first semiconductor companies to release people. Fairchild Semiconductor President, Wilfred J. Corrigan, was quoted as saying, "We spotted the slowdown in 1974 and started slowing down production." The company was battered by the 1970-71 recession before.

A tin plating facility was also added in 1977. The S$1 million investment in a tin-plating plant was reported in The Straits Times. It was also mentioned that the plant will take over the tin-plating activities in Fairchild South Korea.

There were also a lot of changes in the assembly process during Fred's assignment in Singapore. When he arrived, the Plastic DIP wire bonders were the Z-Stick bonders manufactured by Fairchild. The UPH (units per hour) on 14 leads Plastic DIP was 60 and required a subsequent operation, called "tail pull" to remove the wire tails left from the bonding operation. As gold wires were used for the Plastic DIP bonding, several operators were caught attempting to leave the factory with the gold tail remnants in their mouths. On 12 March 1976, The Straits Times reported that Maudreen Wee Peck Neo, 23, a trade union leader at Fairchild Singapore was acquitted of a charge of stealing four spools of gold wire after the court heard that she had been framed.

Model 478 wire bonders from K&S were later introduced which was tail-less and had a UPH of 90. When Ed Fields introduced the second bond positioned, the UPH was raised to 120. Eventually, fully automated Shinkawa wire bonders were introduced increasing the UPH several orders of magnitude. The labour rate in 1972 was US$0.25 per hour for direct operators at an exchange rate of S$2.82.

In 1976, Chris Reardon became the Group Managing Director for Fairchild Singapore and Indonesia. Fred Stillger took over as the Managing Director for Fairchild Singapore serving for two years before returning to Fairchild Mountain View in 1977. "Fairchild was unionized by the Singapore Industrial Labour Organisation (SILO) during my watch," recalled Fred. "We worked with Mr Soman of SILO, Phey Yew Kok of the NTUC and the Fairchild representatives were Michael Wong and Annie Chua."

After leaving Fairchild in 1978, Fred took on positions as Director of Manufacturing Engineering and Subcontract Management with National

Semiconductor and subsequently AMD. At AMD, he worked for Don Brettner from 1984 to 2001 when he retired.

During Fred's tenure, the following expatriates were in Singapore: Wayne Carlson, Paul Filorowski, Jim Ballard, Bill Watson, Joe Shagday, Chris Reardon and Max Maydew. There were also regular US visitors like Mendel Martin, Cy Hannon, Jon Slusser, Mike Morrissette, Peggy Jewitt from South Portland, Maine and Connie Pasqua, Joe Singh Deo, Chuck Anderson, Jim Murphy, and Chuck Smith from Mountain View, California.

Among the many local staff, Fred remembers fondly working with S S Leong, Patricia Lim, Betty Ho, Monica Tan, Helen Fang, K Y Wong, K G Boon, Y H Yeo, John Chan, Murphy Teo, Stanley Tan, C E Tan, Willie Chan, K S Lau, Lawrence Lee, K W Sin, Mary Yeo and many others.

"Singapore is a very memorable place for me and I still consider it as my second home having lived there for 5 years and making over 100 trips the past 40 years," said Fred Stillger. He was able to rent a bungalow on Andrew Road at Caldecot Hill on one acre for S$1,500/month. He could have purchased the house for US$90,000 as it was legal at that time for a foreigner to purchase such property. Fred lived there for 5 years for the same original rental as the landlord did not want to raise the rent and have to pay more tax. "It was a beautiful colonial house with air-conditioning only in the upstairs bedrooms. There were no windows downstairs, just shutters and ceiling fans which we found to be very comfortable," recalled Fred. As for the car, it was a non air-conditioned 1968 Triumph car, a British car. "When I sold the car eventually, I got more money than what I paid Stanley Tan for it originally," recalled Fred.

Fred also remembered that in 1972, C K Tang Department store was only a shop house at the corner of Scotts and Orchard Road. The Marina Mandarin was under construction using external bamboo scaffolding and several workers were died in accidents at the site. As for eating, the Orchard Road and Tanglin Road Car Parks were favourite night eating spots while the Golden Phoenix Restaurant at the Equatorial Hotel served Sichuan food. The Chin Chin Bar in the Hyatt was a popular "watering hole" after work.

CHAPTER 4

1975: Official Opening of Factory Two

"Factory Two will house the final test and finishing operations."

Minister for Finance, Mr Hon Sui Sen, declared open the test and finish factory of Fairchild Singapore at Toa Payoh on 5 August 1975. "We will also continue to encourage more investments in the manufacture of high quality electronic components and consumer electronic products," declared Mr Hon.

Fairchild Singapore invested $15 million in its first factory in 1969 to assemble integrated circuits. The company added $9 million in fixed investments with Factory Two that will house the final test and finishing operations on integrated circuits. The latest investment brought to Singapore more sophisticated technology, a greater investment per worker and a higher degree of skills and engineering.

Headcount at Fairchild Singapore was reported to be in the region of 2,300 workers.

Factory Two up – circa 1975

Fairchild Singapore – circa 1975

Fairchild Singapore – circa 1975

CHAPTER 5

1977-79: Bruce's Leadership

"In the late 70's, Fairchild Singapore shipped 50 per cent of the revenue for Fairchild."

After two great years in Korea, Bruce Stromstad was asked to move to Singapore to become the Operations Manager reporting to Fred Stillger. Fred had been Plant Manager for about a year after taking over from Chris Reardon.

"I remembered the trip to Singapore very well because my wife, Yoon and I were late to the airport and we missed out flight to Singapore because of her visa and passport problems," recalled Bruce. "We got stuck in Korea for an additional four days because of a Korean holiday where the government offices were closed and we could not clear the visa problem quickly."

Bruce finally arrived in Singapore in late January 1977. "I reported to Fred Stillger for about six months before he was reassigned to Mountain View, California," said Bruce. He took over as Managing Director in June 1977. Jim Ballard and Wayne Carlson were the other two expatriates at that

time and the local team consisted of John Chan, Stanley Tan, Willy Chan, Murphy Teo, H S Chew, Frankie Tan and Lawrence Lee.

Together, a number of significant enhancements were made to the Fairchild Singapore facility. As a result, 50 per cent of the revenue for Fairchild Semiconductor Corporation was shipped out of the Singapore plant in the late 70's.

A May 1979 Business Times report indicated that Fairchild would centralise its high technology testing facilities in Singapore in a revamp of its production facilities in the Far East. According to the article, group policy has propelled Fairchild Singapore to expand its capacity to a volume accounting for more than 40 per cent of the group's total output. New sets of testing equipment, each costing $200,000 had been installed. The centralisation of the group's testing facilities for the region in Singapore was to serve production outlets here as well as in Hong Kong, Korea and Indonesia. Singapore will also be the first to absorb any new product development made by the group.

In line with the expansion of production and testing capacities, it was reported that the production of consumer items in Singapore would be phased out. These included digital clocks and watches which were produced by Exetron CPG, a wholly-owned subsidiary of Fairchild Singapore.

The semiconductor devices that Fairchild Singapore assembled then included metal oxide silicon (MOS), bi-polar and integrated circuits.

The Business Times (15 September 1979) reported that $43 million was invested by Fairchild Singapore to expand its testing and automated production facilities. Meanwhile the workforce increased from 2,700 to 4,300.

In the Ceramic Packages (CERDIP) assembly operations, Stanley Tan and Bruce developed the A/B boat process to improve the handling of the components from one process to another. According to the Business Times article, some $13.2 million was spent on more automated machines. This has raised assembly capacity four-fold.

By automating its labour-intensive operations, Fairchild could divert assembly line workers to its expanding testing facilities. Formerly, assembly worked formed about 70 per cent of its workforce (2,700 workers in early 1978). "Now, only about 30 per cent of its 4,300 workers are on the

assembly lines," according to the Business Times report. Frank Ellis moved to Singapore to take Wayne Carlson's place in 1978 and worked with the team to build the largest IC test facility in Asia at that time.

Fairchild Singapore Advertisement for Operators
(Source: The Straits Times 8 August 1979)

Jim Ballard, the production inventory control manager, set up the finished goods hub that became the biggest shipping centre for Fairchild Semiconductor Corporation. The same Business Times article reported that the investment in the warehouse was $4.4 million. Jim was reported to have said that the value of output per worker had risen by another 20 per cent with the investments.

The tin plating workshop was built during this period with an investment of $1.5 million according to the same Business Times article. It took over part of the tin-plating activities being done by Fairchild Korea.

Harry Van Wickle was hired in January 1979 to be the Asia Quality Manager stationed in Singapore.

The team celebrated the 10th anniversary of Fairchild Singapore around July 1978. "I still have the scissors we used for the ribbon cutting ceremony," said Bruce. "I remember the event was held at a waterpark near the current Changi Airport."

The Straits Times (23 June 1978) reported that Fairchild Singapore stood to gain from the company's "de-emphasis" programme in South Korea, where it had two plants. Because of a substantial Korean wage increase over the past two years and government regulations pressuring American multinationals to give a greater share of the companies to Koreans, Fairchild was relocating some of its operations there to Indonesia and Singapore.

CHAPTER 6

1975 S2 Boon Keng Site

"Fairchild bought Exetron to get into the Consumer Products Market."

The Fairchild Singapore Boon Keng site was known internally as S2. It came about when Fairchild bought Caltex, a company in Santa Clara that makes calculators, watches, games and memory chips. This company had in turn bought a small assembly plant that was making winding coils for the first commercial read and write heads for big mainframe computers. The customer was Memorex. The plant was on one floor in a high-rise building with about 8,000 square feet. It was run by a local Managing Director, H B Chan.

These JTC buildings that the Singapore Government was renting out to prospective industrial companies were originally built for local housing. As a result they were short on power, lighting and air-conditioning. When IC assembly was transferred over, all the power was used up. When the power level dropped one volt, all the wire bonding machines would stop and just vibrate. H B Chan would then run to the power room to adjust the power for each of the variable transformers. When the 60 bonding machines stopped vibrating, he knew that it was as far as he could adjust without shutting down some other line.

The coil winding operations were soon replaced by the digital watch modules which composed of one IC Chip and 17 small pieces including the screws. It was a very reliable and accurate watch that either had the bright-lighted LED numbers or the LCD non-lighted black liquid crystal type. The LED watches required the user to push a button to turn on the LED light to see the time because the battery consumption would be too high if the LED was left turned on. The LCD watch was constantly on but it cannot be seen at night or without light.

Fairchild Singapore S2 on 6th Floor - circa 1975

Sam Ho was the test engineer who characterized the reason for failure for each watch module. The yield was excellent as the failures were addressed. The production of watch modules ramped up to 20,000 units per day, seven days a week. It was the biggest digital watch factory in the world and owned by Fairchild.

The TV Games line was the next product assembled at S2. Fairchild had bought Exetron in 1975 to get into the Video Entertainment Systems market. In addition to digital electronic watches, the Fairchild Consumer Products Group was now responsible for digital clocks, video entertainment systems, and a line of optoelectronic products and watch components.

Fairchild Watch Module Inspection Lines - circa 1975

The Fairchild Channel F game console was released in August 1976 with the distinction of being the first programmable ROM cartridge-based video game console. "Those were the years when the video games market was booming," said S S Leong, who was with Fairchild Sales Division at that time. "Atari and Commodore were the rave."

The Channel F electronics were designed by Jerry Lawson using the Fairchild F8 CPU, the first public outing of this processor. Notably, Robert Noyce worked on the F8 CPU design team before leaving Fairchild to start Intel.

With a lot of games modules and a lot of digital watches shipping everyday from S2, the site was expanded to three floors. The game printed circuit board assembly line was sited on the fifth floor. In those days, when you had to drag equipment up several stairs, an Indian equipment mover would be used to push anything up any number of flights of steps using poles, rollers and crow bars. However, in this case, the board soldering equipment were too big for the staircase. So a hole was cut in the side of the building and the biggest crane in Singapore was used to lift these equipment up six floors. A cable through the hole was then used to pull the equipment into the building. It was very stressful to watch the crane as a couple of times the machine would slip and slide down a few feet scaring the hell out of everyone.

The Fairchild board finally pulled the plug on the Consumer Products Group as they realised that as a supplier to this market, they had to invest in all the plant, machinery, and people and take all the material risk until some individual walks into a retail store and buys a watch or game. At the same time, 20% to 30% of the margin goes to the distributors who have no responsibility for the inventory. They would return all the products not sold during a special holiday for full credit.

Joe Koh joined Fairchild Singapore in 1969. He started work in a housing board factory for DIC focusing on TTLs. The department was headed by K S Lau. When the new factory in Lorong 3 Toa Payoh was up, Joe moved over with the rest of the team. "I remembered visiting K&S for their wire bonders," said Joe Koh. At one time, Joe was also involved in tin-plating headed by T H Lim and Dr. Chan. He was also involved in the lead straightening process before test. This is to avoid the PDIP units being jammed in the testers.

K Y Lim became an employee of Fairchild in October 1975 when Exetron Consumer Products Group Pte Ltd was acquired by Fairchild. The Exetron operations were located at S2. K Y Lim relocated to Fairchild Toa Payoh in October 1980 as Assembly Planning and Production Control Manager under Dean Chandler. Became Logistics Manager thereafter, then ran CMOS Standard and Hi-Rel Test before working at Back-End. K Y Lim left Fairchild in April 1986 in search of a better environment for growth.

The Business Times announced on 3 May 1979 that Fairchild Singapore has decided to phase out the production of consumer items in Singapore. These include digital clocks and watches which were produced by Exetron CPG, a wholly-owned subsidiary of Fairchild Singapore.

The company is also reported to increase the labor force from 3,750 to 4,500 workers in 1979.

B Y Teo joined Fairchild Singapore on 13 August, 1979. She reported to work for the first two days at the Toa Payoh location before being stationed at S2. B Y Teo started as a Production Supervisor working on shift with fellow supervisors like P K Lee, Angela Mak, Elsie Chook and Flora Wong. The department head was Joe Koh who had responsibilities for Engineering, Production and Quality Assurance.

"The operations at S2 were wire bonding, testing, and mold operations," recalled B Y Teo. "At one stage, we were reporting to Richard Tan, the night shift manager. We enjoyed the hard work and the 'night out supper'."

The S2 site was closed in 1984 and the operations moved over to the main plant at Toa Payoh. "I missed the life at Boon Keng," recalled B Y Teo. "The work was tough but life was care-free."

At Toa Payoh, B Y Teo and the team of assembly supervisors reported to Madam Chua Mui Koon who in turn was reporting to Michael Tang, the Manufacturing Manager. Both of them came from TI Singapore. Together with a few other managers from TI Singapore, they implemented the TI style of management. "In the beginning, it was tough reporting to them," recalled B Y Teo. "They were very demanding and were pressing for throughput and results." B Y Teo and the group of Fairchild production supervisors managed to adapt and gained the respect and appreciation from the management for their commitment and contributions to the department.

In 1989, soon after National Semiconductor acquired Fairchild, the Plastic DIP assembly operations were transferred to Penang. The team of production supervisors were then moved to Standard Ceramic Assembly reporting to Chua Mui Koon as well as End of Line and Test Operations reporting to F T Liu.

B Y Teo left National Semiconductor in 1995 after 16 years as a production supervisor. "There were plenty of frustrations at work with the operators but there were also lots of fun," recalled B Y Teo.

Johnny Yeo joined Fairchild Singapore in 1983 and left in July 1986 to pursue a career in sales. He worked in S2 and reported to Joe Koh. "There were many challenges with the setting up of the chip and wire production and then moving it to the Toa Payoh plant," recalled Johnny. "But there were also many parties and outings during those days. Morning tea breaks were spent at the nearby Bendemeer Road coffee shop."

The other colleagues in the team were Kelvin Soh, Sandy Lim, Steven Tan, T H Lim, T C Tan, Low Puay Koon, Flora Wong, Serene, K Y Lee, K Y Lim, K Y Chan, Nicholas Liew, Michael Tan, Y K Lee, P K Lim and Christopher Wee. For many of them, this was their first job and many got married during that period and started their families.

Eddy Tang joined Fairchild Singapore Boon Keng site in 1984. He was working on the Beam Tape process. When it was moved back to Toa Payoh, he left the group and joined DIC Assembly as a process engineer.

It was reported in the 1978 Fairchild Annual Report that the Singapore manufacturing and test complex houses the largest installation of Beta (beam tape) automated assembly equipment of any facility of Fairchild or its subsidiaries. Beta machines product integrated circuits at extremely high speeds, up to 40 times faster than by previous methods.

The Beta Product was eventually phased out in 1987.

CHAPTER 7

1979: A Schlumberger Company

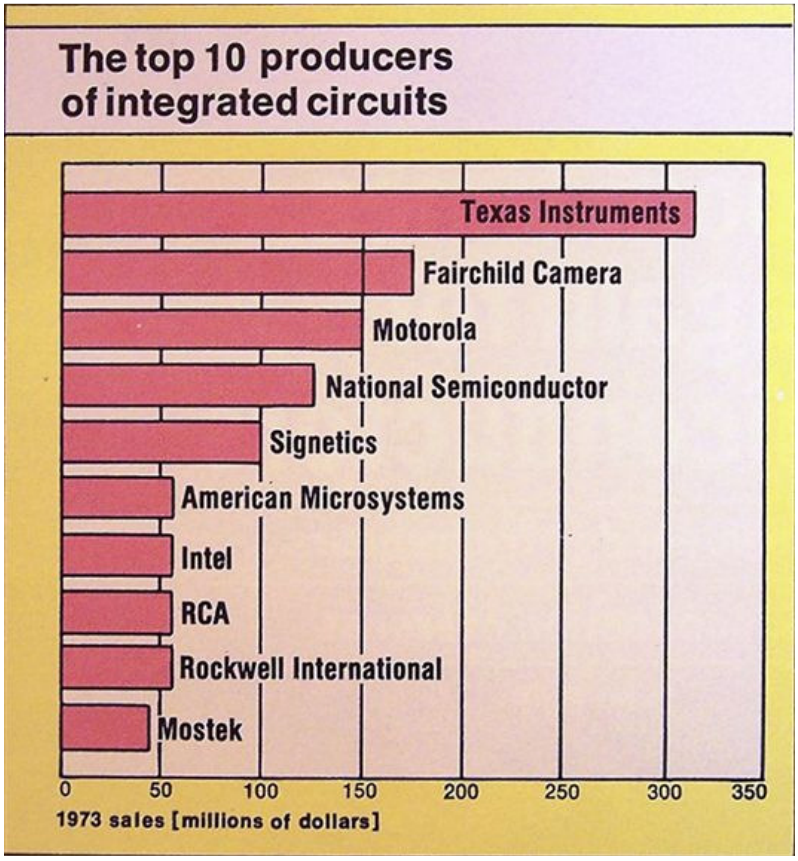
"Fairchild Semiconductor was sold to a French oilfield services conglomerate in 1979!"

Because of the rapid growth spurred by the outpouring of ideas and innovation, the young company ran into difficulties meeting customer demands, retaining employees, and managing operations. Rather than invest in expanded semiconductor manufacturing capacity and personnel, the parent company decided to drain its semiconductor profits to finance other ventures.

Fairchild was caught in this famous trap of living off what they had done well but not really obsoleting themselves with newer technology. The company was the world leader in bipolar technology at that time and ended up under-investing in MOS technology at a time when MOS was taking over the world.

The exodus of talent combined with a capacity shortage, an increase in competition, and a steep economic downturn brought about the end of Fairchild's glory days. In 1979, after a hostile takeover attempt by Gould, Fairchild Semiconductors was sold to a French oil-field company

Schlumberger Limited for US$425 million as part of a diversification effort. At the time of the hostile takeover started, the stock price was US$16 a share and by the time it was sold to Schlumbeger, it was US$66 a share.The shareholders and most of the Fairchild Management made a lot of money on their stock options. After the sale, Wilf Corrigan, the Chairman of Fairchild, left to found LSI Logic in 1980.



The Top 10 Producers of Integrated Circuits – 1973 Sales

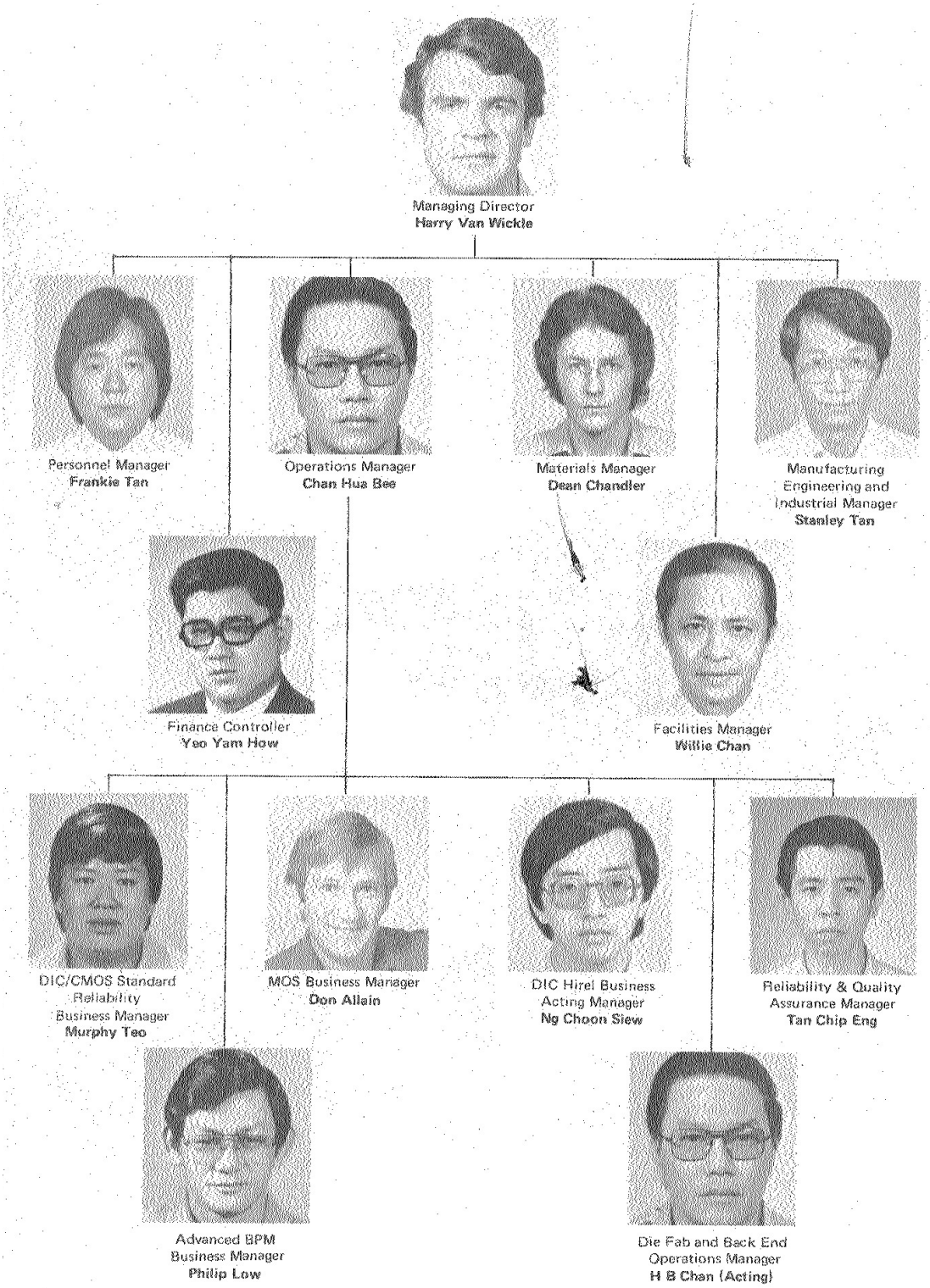
Bruce Stromstad was the outgoing MD at the time of the sale. "I remember being invited to a couple of Schlumberger social events because they had about 50 expatriates living in Singapore and supporting the drilling operations in Indonesia," recalled Bruce. He did not remember much impact on the Singapore operations just before he left for South Portland.

Bruce's assessment of the Schlumberger acquisition: "Tom Roberts was brought in to be the CEO of Fairchild as a result of the acquisition," said Bruce. "He came from a finance background and did not understand the semiconductor business at all. In the early years of the acquisition, there was almost unlimited money available for capital investment. Schlumberger wanted to kick start Fairchild and thought they could do so by throwing money at us. I think the Schlumberger deal fell apart because they underestimated the technology. They believed that good management could solve all problems and this idea did not seem to apply in the semiconductor industry where technology dominates."

Harry van Wickle took over Bruce as the Managing Director of Fairchild Singapore Pte Ltd when the sale took place. "We were all excited about the sale," recalled Harry. Schlumberger pumped in a lot of money to try to revive the company.

The Straits Times reported that year that Fairchild Singapore, the Asian centre, was to spend about $43 million in 1980 to upgrade its operations. The bulk of the investment will go to expanding its testing and automated production facilities. This included the use of automated marking machines using laser technology which can mark chips at ten times the rate of the conventional offset press method in use. There would also be a $1.5 million expansion to the plating plant and a $4.4 million warehouse. With this investment, the company would have invested $87.3 million in Singapore for the last decade.

Harry van Wickle became the MD from 1979 to 1981. His senior management team consisted of Frankie Tan in Personnel, Yeo Yam How in Finance, H B Chan in Operations, Dean Chandler in Materials, Willie Chan in Facilities, Stanley Tan in Manufacturing Engineering and Industrial Engineering, and Tan Chip Eng in Quality. The four Business Managers reporting to Harry were Murphy Teo for DIC/MOS Standard Products, Philip Low for ABPM, Don Allain for MOS, and C S Ng for HIREL. The organisation chart appeared in the 1981 copy of the internal Fairchild magazine, FairTimes.



Fairchild Singapore Senior Management Team - 1981

CHAPTER 8

1983 - 1986: Mike Morrissette's Leadership

"Celebrating a Technological Milestone."

In 1983, Mike Morrissette came to Singapore as Managing Director when Don Brettner returned to the US. Because of his close working relationship with Fairchild Singapore, Mike was asked to move to Singapore earlier by the Schlumberger executives. "Our children were at an age where we did not want to attempt that move until 1983," said Mike.

Mike was responsible for the Jakarta plant as well with the MD of the plant reporting to him. This was a period of rapid technological change in the industry. As the wafer fabs were constantly breaking through the barriers that allowed more and more integration, there was a need for more precise assembly equipment. In testing, new software allowed statistically based test programs that reduced test times as product became more complex. The Singapore operations rose to the occasion absorbing new equipment and processes with enthusiasm.

In September 1984, Fairchild Singapore celebrated its 15th year in Singapore. It was a great day for the company who saw the official opening in 1969. "We celebrated the occasion with a Big Walk and I still kept the singlet," said K Y Chan. As can be seen from the photos below, the singlet looked new. It must have been extremely meaningful for K Y to have kept it in pristine condition after 28 years!

However, in 1985, the industry was caught in a major downturn which became severe enough to require major changes in manufacturing. This resulted in the closing of the Jakarta facility and consolidation in Singapore with a few supporting subcontractors.

Mike succeeded in helping the Singapore staff develop a better relationship with South Portland. He also moved the decision making process down the chain to that decisions were made faster and with more people providing inputs. This was revolutionary at that time as most decisions had been top down.

Along with K Y Chan, Mike was also able to bring a design centre to Singapore. "It took quite a bit of convincing back in the US but eventually we prevailed and the design centre was established," said Mike.

Mike's stint with the Singapore operations ended in 1986 where he returned to South Portland as the Director for CIM (Computer Integrated Manufacturing) for Fairchild and subsequently for the combined Fairchild and National Semiconductor operations. Mike had asked to return to the US for personal reasons. At that time, there were some political contests developing between some of the Schlumberger managers and some of the executives who came over from TI. "Some of those TI transplants had a rather arrogant attitude and as a result, they absolutely refused to consider any Fairchild Managers to replace me. I was not involved in the decision to select my replacement in Singapore," said Mike.

"My stay in Fairchild Singapore was the most enjoyable years of my career," said Mike.

Fairchild Big Walk Singlet 1984
(Courtesy of K Y Chan)

CHAPTER 9

1986: Sold to Fujitsu

"Fujitsu proposed to purchase 80% of Fairchild Semiconductor."

IN 1985, Donald W. Brooks, a former Texas Instruments engineer who started his career with Jack Kilby became president of Fairchild. Don realised that Schlumbeger knew nothing at all about the business. They put a guy in there to run it who knew absolutely nothing about it. As a result, all of the former management left and took all those people who mattered and it became tough for Fairchild to survive. Don Brooks decided finally in 1986 that the best solution was to try to sell Fairchild to Fujitsu.

Fairchild has lost US$175 million in its 1985 fiscal year and was expected to lost another US$75 million in fiscal year 1986. Schlumberger has tried to sell Fairchild to a U.S. firm for several months, but there was no interested buyer. Don Brooks was concerned that Schlumberger might completely shut down Fairchild.

The announcement was made on 25 October 1986 that Fujitsu, one of Japan's leading computer and semiconductor makers, will buy Fairchild Semiconductors. The firm will acquire 80 per cent of the stocks of the California-based firm from its stockholders, Schlumberger Ltd.

Two months earlier, Bock Seng had announced in the Straits Time (13 August 1986) that the company will continue to invest in greater automation of the manufacturing processes. "For the next three to five years, Fairchild will invest US$7 million to US$10 million a year on new automation equipment to keep itself at the forefront of the industry," said Bock Seng.

In January, plans to expand and move the memory division into a new 3,716 sq m factory site in Bedok later in the year was also announced.

Unfortunately the Fujitsu deal was blocked by the US Government for fear that technology might fall into the hands of the Japanese. By March 1987, the deal was over.

As a result, Don Brooks decided to head a management team with plans to buy Fairchild from Schlumberger and join Fujitsu in a scaled-back venture. "Fairchild and Fujitsu will continue with their plans to join forces in all other areas, including technology exchange, second-sourcing and foundry agreements," said Don Brooks. "Fairchild will benefit from Fujitsu's manufacturing savvy and advanced memory chip technology, while Fujitsu would gain access to Fairchild's US distribution system as well as its high-speed logic chips."

F T Liu, assembly process engineer remembered that contact was made with Fujitsu Japan to process their SRAM wafers for assembly and test in Fairchild Singapore. "As part of the qualification process, we requested for reject wafers to set up the die saw, die attach and wire bonding operations. These are wafers which have poor electrical yields. They are typically full of ink dots as the failed dies are marked accordingly at wafer sort," said FT. The reply from Fujitsu Japan was simply "Sorry, we do not make reject wafers". We were amazed.

When we received the good wafers for assembly, we were impressed with the few ink dots we saw versus the large number of ink dots we were used to on Fairchild wafers.

Finally, we took some of the dies and did a cross sectional analysis and found that they had 10 metal layers versus 14 for Fairchild's SRAMs. No wonder the Fujitsu SRAMs were faster and cost less to produce.

CHAPTER 10

1987: Sold to National Semiconductor

"National Semiconductor only paid a hundred million in cash."

Eventually, the premier semiconductor company in the world was sold to Charlie Sporck's National Semiconductor in 1987. National Semiconductor only paid a hundred million cash.

In Singapore, the National Semiconductor plant at Lower Delta was shutdown and the operations was merged with Fairchild's operations at Lorong 3, Toa Payoh in 1988. The combined headcount was 3,800 employees. Tan Bock Seng assumed responsibility for the merged operations while Ron Ho, former MD of the National Semiconductor plant at Lower Delta was moved to a regional role at the National Semiconductor Asia Pacific Office. He was responsible for management information services and materials and production control. Both gentlemen reported to Ron Sato, the Vice President for Asia-Pacific operations.

CHAPTER 11

Birth of the Semiconductor Industry in Singapore

"The potential for progress appears to be limitless."
Hon Sui Sen
Minister for Finance
Official opening of Fairchild Singapore Factory Two
Tuesday, 5 August 1975 at 4.30 pm

The first semiconductor companies were established in Singapore around early 1969 with Fairchild as one of the pioneers. These companies had quick success in their initial operations and expanded rapidly. The annual output of the semiconductor industry increased from nothing in 1968 to 130 million dollars in 1970; 290 million dollars in 1972 and 470 million dollars in 1974.

The semiconductor industry has contributed significantly to Singapore's economy. In its early days, it helped Singapore achieve near full employment and created many jobs, particularly the female workers. The successful start up and rapid expansion of multinationals such as Fairchild in 1968 and 1969 put Singapore on the map as a profitable location for

international manufacturing companies. Further, the demand created by the semiconductor companies led to the setting up of a wide range of support services and industries such as those for the maintenance, repair and calibration of sophisticated electro-mechanical production equipment and electronic test instruments; the supply of high purity chemicals and gases; and the fabrication of precision metal products such as lead frames and carbide dies.

Most of the semiconductor factory operations carried out in the early days was relatively simple, involving mostly manual assembly by large number of female workers. But it was not reasonable to expect that Singapore could in one leap span the alpha and omega of the complex semiconductor industry. However, it has surely taken the first steps in the development of an integrated electronics industry in Singapore which must eventually incorporate all the latest and best in the state of very many different arts and technologies.

In keeping with progress, the semiconductor industry has increasingly used automation in production, moved into more complex and higher value product lines. Fairchild, for example, expanded its operations forward from assembly into testing and finishing with the setting up of factory two in 1975. The value added by each worker increased by leaps and bounds in tendon with an improvement in living standards. Greater complexity and technology in the products also required technical and professional personnel in the industry.

The Singapore Government at that time has already decided that there is vast potential in the electronics industry for further advancement. The electronics industry encompasses a very wide spectrum of sophisticated products. Its technology continues to advance rapidly with the discovery of new applications and the creation of new markets. The potential for progress appears to be limitless.

Singapore continued to encourage new investments in the electronics field, especially those that will lead to further integration and upgrading. For example, from the back-end assembly and final test operations, the Singapore Government encouraged front-end projects such as wafer fabs. Through the Economic Development Board, the government offered tax incentives of up to 10 years pioneer status, generous training grants, as well as financial support through the capital assistance scheme.

At the same time, further forward integration into the manufacture of electronic products which use semiconductor devices such as electronic watches, sophisticated electronic calculators, cash registers, and computers were strongly courted to Singapore.

CHAPTER 12

Aerospace & Defence Division

"The products were tested to Mil-883C specifications."
Frankie Tan
Department Head
A&D Division

Fairchild Singapore was organised into three divisions in 1983 - the Aerospace & Defence (A&D) Division, the Memory & High Speed Logic (MHSL) Division and the Digital Integrated Circuit (DIC) Division.

Fairchild Semiconductor had benefitted from the purchase of unprecedented volumes of semiconductors by the Department of Defence engaged in a mounting Cold War with the Soviets. The vast majority of the early customers were aerospace firms buying products to use in their own government contract work, and these customers developed specifications that reflected military requirements. Products offered to this market are part of the A&D Division. While Fairchild courted the industrial and commercial markets, its products nonetheless could also be found in

surveillance radar and transmitters for space vehicles; in Polaris, Minuteman, and Advent missiles; and in the MAGIC airborne inertial guidance computer, as well as the MARTAC missile control computer.

Monica Foo joined Fairchild Singapore in 1969. She started as an assembly operator in the night shift with the late Venus Han reporting to Leo Teng Yong, the Superintendent. Venus eventually was with the document control department under QA.

Monica subsequently applied for the position of typist in the Purchasing Department. "There were only three of us in the department," recalled Monica. "T K Khoo the Purchasing Manager, Cindy Chia the Buyer and myself." T K Khoo and Willie Chan, who was then the Maintenance Engineer, were both reporting to Don Spurling, the facilities and Maintenance Manager. When Don left, Willie took over his job with Elizabeth Loh as his secretary.

When the position of secretary to Fred Stillger, Engineering Manager, and Joe Shagday, Production Manager, was vacant, Monica applied for it. Reporting to Fred at that time were C E Tan, Stanley Tan and Sam Lim. When Fred Stillger became MD, Joe Shagday returned to the United States and his position was taken over by John Chan. Monica then reported to John Chan and K W Sin, the QA Manager.

Later Tan Chip Eng took over from K W Sin as QA Manager while Murphy Teo took over from John Chan. When Tan Chip Eng left Fairchild, Lee Wah Kee took over as Plant QA and Murphy had his own secretary, Pearlyn Tan. Monica was also supporting Harry van Wickle who had Regional QA responsibility before he was promoted to MD.

Stanley took over as the Engineering Manager with May Hui as his secretary. Stanley later left to join Harry Van Wickle at Honeywell and Sam Lim left to start his own business KES Systems providing burn-in services.

When the Aerospace & Defence Division was formed with Frankie as the Department Head, Monica became his secretary. Subsequently, Monica supported Paul Lones who took over from Frankie and when Paul returned to the Americas, Wan Choong Hoe took over. When Wan Choong Hoe was promoted to become MD, Monica was transferred to support Grace Yow in Assembly and T F Han in Test. And just before she was retrenched in 2003, Monica was supporting Vivienne Tan in IT and Grace Yow in Assembly.

After 34 years with Fairchild Singapore and subsequently National Semiconductor, Monica remembers some of the many colleagues – Gunther Haller, Dean Chandler, Jim Ballard, H K Sim, Ben Thumboo, Lim Meng Swan, all from Planning and Control Group; Nellie who was the secretary to Frankie Tan when he was the HR Manager; S J Lim from IT; Joe Lim from Store, K S Lim from HR; Martin Wellan, Dr Chan and T H Lim from Plating; C S Ng from Industrial Engineering and later MHSL; H B Ng, T B Wah, Y Y Lee, Janet Tan from QA; K C Low from Finance; and S H Hoon from Facilities.

Y T Sim joined Fairchild Singapore on 19 December 1977 as a Line Mechanic to start up the burn-in equipment maintenance. "My starting salary was $360 a month. It was enough for me then," recalled Y T Sim. "The interview was very fast, only one question - 'When can you start work?'" Burn-in is the process of stressing semiconductors to weed out potentially weak devices. The technique involved subjecting a device to high temperature and voltage stress for several hours or days and exercising it through the limits of its electrical performance. The only effective method of assuring high reliability semiconductor devices is to perform burn-in.

The burn-in set up was on the ground floor of Building D. Later, Y T Sim reported to Heng Nga who was hired to head the maintenance department. Kelly Choo was also hired to assist Y T Sim to set up the burn-in boards repair station. Y T Sim worked with Hoon from plant maintenance to set up the burn-in ovens.

One of the memorable moments for Y T Sim was fighting an oven fire. The burn-in boards were burning in the chamber due to current overload. One of the technicians grabbed a fire extinguisher, opened the oven door and sprayed at the fire. Unfortunately, he grabbed the wrong fire extinguisher, the dry powder type instead of CO2. The dry powder was sucked into the burn-in chamber and soon was released to the whole burn-in room.

Beside the burn-in department were the back end operations. Bobby Pang was responsible for the maintenance of the temperature cycle and centrifuge equipment. Temperature Cycle is a test to determine the resistance of a device to extremes of high and low temperatures as well as its ability to withstand cyclical stresses. Fairchild's HIREL products were

tested to the Mil Std 883 Method 1010 which spells out a minimum of 10 cycles under 6 different temperature conditions such as -55 to +85 deg C to -65 to +300 deg C. Total dwell time is minimum 10 minutes and the specified temperature must be reached in less than 15 minutes. These conditions are tracked on a chart plotter for each temperature cycle chamber and Bobby's job was to make sure that they are met all the time.

In ceramic packages, the die is attached to the ceramic base using a gold perform that forms a eutectic allow with the die at a certain elevated temperature under inert gas conditions. To confirm that the eutectic die attach process is within control, samples are taken during the process to perform a destructive die shear test. A good eutectic die attach process will show almost 100% silicon remaining on the die pad after the die is sheared. Later the gold perform is replaced by silver paste. Centrifuge testing, under Mil-Std-883 is conducted to verify the die attach and wire bond integrity. This test is designed to indicate types of mechanical and structural weaknesses not necessarily detected in vibration or mechanical shock testing. The test equipment must be capable of providing shock pulses of 500 to 30,000 g with a pulse duration between 0.1 to 1.0 millisecond to the body of the device. Bobby Pang's job was to make sure the equipment is properly maintained as this is a very dangerous operation.

When the burn-in operations was sub-contracted to KES, a company formed by ex-Fairchild staff in 1978, Y T Sim was moved to the Test Operations on the second floor of Building D. In test maintenance, Y T Sim worked with S H Neo, Lim Meng Swan, Frankie Tan and production supervisors like S Peter and F H Low. Y T Sim stayed on till the plant was closed in 2006, almost 30 years. "I managed to stay so long because the Fairchild staff was so friendly," said Y T Sim.

Lawrence Lee joined Fairchild Singapore in 1975 when the Test and Finish operations was started. He was recruited from National Semiconductor by Wayne Carlson, the Final Test Manager. "We started with a new empty test floor and filled it up within a year," recalled Lawrence. "We had a very energetic team under Wayne's leadership."

Two years later, in 1977, Lawrence had the opportunity to work under Jim Ballard, the Materials Manager, initially supervising the shipping store and later taking over the purchasing portfolio as well.

The Aerospace & Defence Division came out of the HIREL Division. "Some time in 1978, I was attending a 3-day training conference in a hotel. I was called by Betty Ho, secretary to Bruce Stromstad, then MD, to return to the office the following day," Recalled Lawrence Lee. "I had 2 more days of training left to complete." When Lawrence met Bruce the following day, he was informed that the DIC Department was to be restructured and Lawrence was to head the newly created HIREL (High Reliability) Division assembling and testing products for the US Military. "Mike Morrissette, the Product Group Manager, in South Portland, Maine, called to verify the appointment," said Lawrence. The initial team involved in the start up of HIREL Division were Robert Hong, Lim Meng Swan (Production Assistant Manager), Lee Wah Kee (QA), Robert Goh (Engineering), Jimmy Chew (Engineering), Ms S P Lai (Engineering), Heng and Peggy the secretary.

As Singapore was just the production unit, the HIREL Division inherited all the equipment and processes from the Americas. Within the first couple of months, the Burn-In operation was shut down by a very important customer. The burn-in ovens were found not properly maintained. As a result, the burn-in operations were moved to a sub-contractor. Meanwhile, the in-house ovens were refurbished and the team recovered from this embarrassing event over a few months.

Fairchild Headquarters decided to automate the processes and automated wire bonding was introduced. The first generation Japanese machines were brought in and installed. It was uncertain if the new equipment were evaluated under production environment. Instead of improving the productivity per operator, the opposite happened. It was found that the die design and the bonding equipment were not matched. The equipment bonding height was fixed while the bonding pads on the die were of uneven thickness. The relevant personnel were also not adequately trained. That was the price paid for being the first to introduce automation in the factory.

Towards the end of 1980, Lawrence left Fairchild and joined KES Burn-In Services which was started by former Fairchild employees. He later started Advanced Systems Automation with Jimmy Chew and a few other friends. The baton for HIREL was passed over to the C S Ng (?)

when Lawrence left. "The five years in Fairchild provided me with a wide spectrum of experience and was life enriching," said Lawrence.

From 1981 to 1983, Frankie Tan was the Director of Human Resources of the Digital and Bipolar Division based in Fairchild California. Frankie returned to Singapore in 1983, to become the Director of Operations for the Aerospace and Defence Division reporting to Mike Morrissette. In 1986, when Tan Bock Seng came over from TI Singapore to become the MD of Fairchild Singapore, Frankie moved to Fairchild Semiconductor Sales office to become the Director of Marketing for Asia where he stayed until 1988.

Tan Chong Teck joined Fairchild Singapore in 1981 after graduating from NUS with an engineering degree. "I did my industrial attachment in Fairchild and after graduation, the guys whom I worked for during the industrial attachment hired me," said Chong Teck. "I did not have to much job search unlike my classmates."

Chong Teck's first supervisor was K F Woo who moved to the US plant after a year. As a test engineer, Chong Teck's job was to develop test programs for testing the semiconductor devices as well as developing the required hardware to do the testing. "I was in HIREL, which is basically high reliability devices for military use," said Chong Teck.

In 1991, Chong Teck moved to product engineering which was basically managing the yield of the products. "I had a chance to work with the Israel plant where the wafers were made," said Chong Teck. "They were smart, considerate and hardworking and we worked well together to improve the yield of the products."

After 23 years in the first job, Chong Teck was retrenched in 2004. "My father had just passed away so the management was kind enough to delay my retrenchment for a week after the retrenchment exercise," recalled Chong Teck. After working for so many years in Fairchild, it took some adjustments for Chong Teck to say good bye to so many friends he left behind at Fairchild both in Singapore and overseas. "The surprising part was the Israel colleagues," recalled Chong Teck, "Alex Fichman, my counterpart in Israel continued to call and email me until I found another job two and a half years later." Alex also requested his manager, Aviv to visit Chong Teck who was in Singapore on his way to the India design centre.

David Lim joined Fairchild Singapore in April 1983 after graduation from NUS with a degree in electronics engineering. He was one of two fortunate ones selected from among 20 NUS students doing their Industrial Orientation in Fairchild during their third year of engineering studies. David spent three months in Mountain View, California working in the photo-masking area inspecting four-inch wafers. "It was a very profitable assignment as I was given a per diem of US$30 per day during the three months, a car and a two-bedroom apartment to share with the other IO student," said David. Back in 1982, Frankie Tan was the Personnel Manager at Mountain View and he took good care of us. He even went to the San Francisco Airport to pick the two IO students and drive them to their apartment. "I never forgot those weekends where we had money saved from our per diem to cover many cities and places like Los Angeles, San Diego, Hearst Castle, Las Vegas, Reno, Hoover Dam, and the Grand Canyon to name a few." There was no bond for this overseas attachment but David Lim decided to return to Fairchild to work upon graduation. His partner however chose not to. David Lim started as a test engineer and wrote test programmes for MCT Testers as well as solving test issues in the manufacturing floor. He was reporting to Tan Chong Teck. "Chong Teck was very nice and understanding," recalled David Lim. He left in December 1986 to join IBM doing procurement for the first seven years before moving to their sales division. He is now responsible for IBM Microelectronics sales in ASEAN, India and Australia and New Zealand.

In 1985, F T Liu joined as the manufacturing engineer reporting to C C Ho, the production manager for test and backend operations. This was a new organisation where an engineer was assigned to the production department to address yield issues and to implement statistical process control techniques. Two manufacturing support technicians were hired as part of the team -- N J Wong and Desmond Tan. Our major task was to address the visual/mechanical inspection yield which was also known as A&D CUSFIN (Customer Finish) operations. The average yield at that time was 97.8% and the lot rejection rate (LRR) at outgoing quality was 20%.

A weekly yield meeting was chaired by F T Liu to address the yield and LRR issues. "We did a pareto analysis of the defects based on the

inspection forms recorded by the operators as the parts were 100% inspected under a 3X magnifier. Major problems were illegible marking, package discolouration, solder melt, solder dip reject, QA samples, foreign material, problem carriers for the FPAKs," recalled F T Liu. By aligning the reject criteria with QA and preparing photos of the common grey areas to train the operators, the LRR was reduced to zero within 6 months!

The most interesting change implemented was the use of electrical failures for the QA samples. Good units were taken by QA for destructive mechanical sampling tests and these were yielded off.

It was determined that illegible marking was assignable to the marking process so an attributes control chart was implemented at the marking machine. The marking process was based on transfer marking using UV cure ink. The operator had to check the marking before UV cure and to determine if the marking plates needs to be cleaned. So it was easy to implement a control chart using the inspection data from the operator. Unfortunately, this required additional paper work and downtime due to recording and there was an initial reluctance to sacrifice output to plot the control chart. Also the maintenance technician was an old man named Bobby Pang. It was a challenge to get him to respond to the marking machine when the operator required it to be shutdown due to repeated illegible marking. Bobby used to clean the machine but with the control chart, it was required to record the action taken. This Bobby was reluctant to do. Everyone knew Bobby was quite a character and it was left to the new manufacturing engineer, F T Liu to convince him to cooperate.

Reporting to C C Ho were four supervisors, David Lie, Edmund Yip, Jeffrey Tan, Hamidah, S Peter and F H Low. Ah Tin was providing the administrative support to the group. We were all housed in the same office with the six supervisors sharing one table since they are on three rotating shifts.

Besides C C Ho, the other direct reports to Frankie were, H H Tay (Process Engineering), Tan Chong Teck (Product Engineering), H B Ng (Assembly Operations), Louis Pang (Maintenance), Lawrence Lim (Quality) and P K Cheng (Planning).

H H Tay had H W Tan and Alfred Wong reporting to him. They were responsible for the setting up of new processes to be introduced to production. The current processes became the responsibility of F T Liu

and his two technicians. It was an interesting relationship between the two groups as there were issues that needed to be resolved but the responsibility was not clear.

P K Cheng, as planning manager had a nice daily report sent to all operations heads highlighting the inventory at the various locations. He has a very nice handwriting that will circle the bottlenecks for actions. As the Visual/Mechanical Inspection operations was the last operation before the goods are released for packing, F T Liu had numerous interactions with one of his direct reports, C M Loke. C M Loke is short and he had his hair permed into curls. With his round glasses, he would storm into the production room each morning demanding for a status to the lots on hold. His temper did not help the situation and it was not pleasant dealing with him.

Lawrence Lim, as quality manager, had Chua Mee Eng and David Koh reporting to him. Mee Eng was responsible for the assembly area while David was responsible for the backend area. As the products were built to the military standard 883C, one of the challenges was to interpret the standard. F T Liu decided to study the standard and became competent enough to engage the quality team directly without listening to them blindly.

Paul Lones came over from Fairchild USA to take over the Aerospace & Defence Division from 1986 to 1988 reporting to Tan Bock Seng. He was mechanical engineering graduate from MIT. During those two years, Paul did a great job in improving the product yields by 17%, reducing inventories by 52%, increasing productivity by 90% and reducing outgoing quality defects by 84%.

By then, the company's products were consolidated into Ceramic and Plastic Operations. Within the Ceramic Operations, there were Military/Aerospace Logic Products and Paul Lones took over as the Product Line Manager with profit and loss responsibility for a worldwide business of US$45 million. After a year and a half, Paul became the managing director of the Military and Aerospace Electronics Center from 1989 to 1995. He was responsible for all semiconductor components for the Military and Aerospace markets.

N J Wong joined Fairchild Singapore in January 1986 after completing two and a half years of National Service with the Singapore Armed Forces. "It was my first job and Fairchild, being a large

multinational, gave a newbie like me the opportunity to understand a wide range of activities in semiconductor manufacturing," said N J. The experience he picked up is still helping him to this very day.

N J Wong started as a Manufacturing Technician in a new organisation called the Manufacturing Engineering Group under A&D. Together with another Manufacturing Technician, they both reported to Manufacturing Engineers, F T Liu and David Koh. The task of the team was to study and improve manufacturing processes in the Test and Finish operations before the goods were shipped to customers. The group reports to a Manufacturing Manager by the name of C C Ho.

In the first week of work, N J Wong realised that even as he was inducted into his new work place, other staff who have been working there since the early 70's, were being retrenched. It was an experience that would be repeated a number of times during his three years with the company. In fact, one of the "casualties" was C C Ho, who was responsible for creating the Manufacturing Engineering Group in the first place. Thus the fate of the Manufacturing Engineering Group was already in flux before N J Wong started work. T H Lim has already taken over the position when N J Wong turned up for his first day of work. N J did not meet C C Ho until a few weeks later when the group under C C visited him for Chinese New Year.

"I remembered our office was overlooking the production floor. It was an open office and there were no partitions. T H Lim, the Manufacturing Manager sat at the back left corner of the office where he could see everyone and the production floor. Sitting in front of him was Grace Teng Ah Tin, the clerk," recalled N J Wong. "Both T H Lim and Ah Tin were fat, so the joke was that T H Lim is not 'Slim' and Ah Tin is not 'Thin'." The Manufacturing Engineering Group was seated in the centre and the Supervisors along the right side. The Supervisors were Jeffrey Tan, S Peter, Hamidah Yusoff, F H Low, Kelly Choo, Edmund Yip, and C M Tan. David Lie was the Senior Supervisor and his task was to coordinate with the Supervisors on all production related work. "I remember David Lie often teased Ah Tin about her size," said N J.

Some operators were assigned to support the Manufacturing Engineering Group by collecting defective products from the production floor for analysis. There were three types of ceramic packages processed –

dual-in-line packages (CDIP), flatpacks mounted on plastic carriers (FPAK) and small outline integrated circuits (SOIC). Defects include chipping, bent leads, holes in the hermetic seal, illegible marking, discolouration in the leads, wrong orientation, and poor solder coverage. CDIPs were prone to chipping, FPAKs have bent leads and the markings on the SOICs are often rubbed off the gold surfaces.

The operators screening these visual defects were known as CUSFIN (Customer Finish) operators. They will write on a worksheet the number of rejects screened for each lot. Angie Leong, the senior operator, will then input the data into a Lotus 123 spreadsheet and generate a pareto analysis for management review. Lotus 123 was good for data analysis and presentation but was time consuming for data entry. N J Wong then wrote a dBase 2 program to facilitate the data entry. A Lotus 123 spreadsheet that has a macro that will automatically import the data from the dBase 2 program will then prepare the management report. "I remembered that the PC, running on MS DOS 2.0, had no hard drive but two floppy drives that only reads and writes 360k floppy disks," said N J Wong. "It is simply amazing that a single 360k floppy disk could contain the dBase 2 EXE, the Lotus 123 EXE, the dBase 2 Program and the Lotus123 spreadsheet with the macro, and the weekly data files!"

There was another PC in the office that was put up by the Automation Department to track tester downtime. A siren with flashing red, green and orange lights was installed on every tester. Each lamp was controlled by its own switchbox which was controlled by the PC in the office. When a tester id down, the red light will flash and the siren will sound to attract the attention of the maintenance technicians. When the tester is being attended to by the technician, the orange lamp will light up. When the tester problem has been fixed, the green lamp will resume. The concept was great but the problem was that the lamps themselves were often faulty. Without management commitment to demand the tester downtime report from this project, the lamps were eventually dismantled and the automation PC was recycled as a general PC for office use. "This was the first 'white elephant' project I witnessed," said N J Wong.

A few months later, the A&D and MHSL Divisions were merged to form the Ceramic Operations. Desmond and N J Wong reported to Process Engineers Steven Ang, Lawrence Koh and Clayton Tan who in

turn reported to K C Lau, the head of the backend operations engineering. Three operators were attached to the Process Engineers, Wendy Lee with Steven Ang, Ani with Lawrence and Titi with Clayton Tan.

F T Liu left the backend operations to join the assembly operations engineering group under Dax Kwoh while David Koh went to join the Automation Department.

CHAPTER 13

Memory & High Speed Logic Division

"We were assembling and testing SRAMS with wafers from Puyallup, USA."
C S Ng
Department Head
MHSL Division

Fairchild Singapore was organised into three divisions in 1983 - the Aerospace & Defence (A&D) Division, the Memory & High Speed Logic (MHSL) Division and the Digital Integrated Circuit (DIC) Division.

Prior to being MHSL, it was known as the Advanced Bi-Polar TTL Memory (APBM) group under Philip Low. Later C S Ng took over from Philip as the department head reporting to Mike Morrissette.

Nelson Koh joined Fairchild Singapore in 1973 in the assembly maintenance department reporting to K S Low. This was part of the Bi-Polar Division and the MD was Chris Reardon. Peter Kwan was the head of Maintenance. He was the one who implemented the semi-automatic wire bonders from Shinkawa, Japan. Later Peter left to join UTI, the vendor who is the agent for Shinkawa. From process engineering was N K

Loh. Nelson left the company in 1988 to AT&T. He remembered fondly the one year he was stationed in Fairchild US at 466 Ellis Street. He was working with Rick A, Paul S and Terry Tan there.

P E Tan joined Fairchild Singapore in 1979 as part of the MOS process engineering reporting to C E Tan who in turn was reporting to Frank Ellis. He remembered working with K Y Wong, N H Lee, Lawrence Koh. Some of the supervisors he remembered well were J M Kow and Chong from QA. Both the gentlemen were running the union in Fairchild. When the MOS group became part of MHSL, P E Tan joined Dax Kwoh's process engineering group. Later P E Tan moved to purchasing where he was responsible for dealing with the leadframe vendors.

H H Tay joined Fairchild Singapore in 1979 as a product engineer with the Bipolar Group reporting to K Y Wong, the Product Engineering Manager. Later he became the Product Engineering Manager reporting to Philip Low. When C S Ng took over from Philip, H H Tay moved over to A&D reporting to Frankie. H H Tay left Fairchild in 1987.

K Y Chen joined Fairchild Singapore on 13 August 1980. He worked as a test engineer under Ng Mong Teng, the Test and Maintenance Manager. When Mong Teng left not long after he joined, K Y Chen reported to Lincoln Ee. The other bosses he had were T K Tay for Mil-Aero Products, and after the acquisition by National Semiconductor, Y C Ng for ASICs and Francis Tham for Mil-Aero Digital and Analog. K Y Chen left the company in October 2003 after 23 years to start his teaching career.

C C Chia joined Fairchild Singapore in September 1980 soon after graduating from the University of Texas. He worked in Product Engineering and worked on the testing of Advanced Bi-Polar TTL Memory (ABPM) devices. "They were specifically used for cruise missiles and for the CRAY supercomputer," said C C Chia. The section managers were H L Ng followed by K Y Wong and then H H Tay.

T K Tay joined Fairchild Singapore on 21 October 1980 through a walk-in interview conducted by H L Ng in Kuala Lumpur, Malaysia a few weeks earlier. He was hired as a Product Engineer in ABPM Division under H L Ng's organisation. H L Ng was the Engineering Manager reporting to Philip Low who was the Business Manager. "In those days, Product Engineers were expected to understand key processes from

assembly to backend as they may affect test yield," recalled T K Tay. "When there is an assembly related failure, we just popped into the assembly floor (in office attire) to check on the processes. There was no requirement to wear face-mask nor was there ESD control as the clean room concept was not in place then."

The scriber was the first step in the process. It is a machine with a diamond-cutting tool that was guided across the wafer in the scribing tracks which separated each row of ICs. You had to set up the machine to the correct stepping, and then align the diamond-cutting tool to the tracks. After that the machine will do the rest. After the wafers were sawn, the "good" dies were individually picked and placed into wafer pack trays for die attach. The die-attach operation was manually done where the operator used tweezers to pick up the die and mount it on a pre-heated package using a heater block. Bonding was a highly skilled process where the operator manually threads fine gold wire between the bond pad and the leadframe.

As personal computers and the Internet were not in existence then, communication with the U.S. was carried out by passing a hand written message to the clerk. The message was then sent through a telex machine. A few days were required before a reply comes through telex.

TTL Memory Products, with densities of 256 to 4k bits, were tested using a Xincom Tester. High Speed Logic, Emitter Couple Logic, NAND/OR gates were fastest with pulse rates of up to 1 GHz. There was no tester capable of testing such high speeds at that time so only functional and parametric tests were conducted using the Sentry and 5000C tester. The latter was a true grandfather tester using 100% mechanical relays to control switching functions and one could hear lots of relays clicking when test was in progress. Fairchild's ECL devices were state-of-the-art at that time and used extensively in the CRAY supercomputer - up to two hundred thousand units per system, incredible!

Those were good times and it was common to take long lunch breaks. Some even drive all the way from Toa Payoh to Pasir Panjang for the famous boneless duck! There was a basketball court and a football field in the plant where regular inter-department volleyball and basketball competitions were held. "It was common for the nearby HDB residents to

complain when some graveyard shift workers decided to have a go on the football field," recalled T K Tay.

Daily operations review was non-existent until Tan Bock Seng came along. "We were hit by a culture tsunami – daily operations review, 95% ATY yield, 98 percentile cycle-time, operational cleanliness and discipline …end of the good old Fairchild days!" lamented T K Tay. A few years after National Semiconductor took over, T K Tay left the company in 1995.

Katharine Ho Siow Yong joined Fairchild Singapore in February 1984. It was only her second job. She reported to T K Tay in Product Engineering in the RAM (Random Access Memory) group and the Section Head was K Y Wong. At that time, C S Ng was the Department Head and Mike Morrissette was the MD.

Katharine replaced Linda Ho who was relocated to Puyallup, near Seattle, USA. There was a relocation opportunity for engineers from the Toa Payoh plant to Puyallup back in 1983 to 84. "I was impressed byt he new advance memory testerd," recalled Katharine. Some of the colleagues Katharine Ho worked with include C C Chia, Lim Sok Hia, Peter Tan, David Lee, Neo Lay Hiang, S S Ho, K B Chan and W S Loh.

When Bock Seng came on board in 1986, there was a major lay off in September. "This scared the hell out of me as it was my first ever encounter with a massive layoff after working in Singapore for four years," recalled Katharine, a Malaysian. "Many of those who were axed were our seniors and we had to do their jobs without any of their pay." With rumours of another round of layoffs, there was panic among the junior engineers, especially those from Malaysia. "We quickly looked for jobs and jumped into the growing hard disk drive industry without knowing what was a hard disk," said Katharine.

Katharine left Fairchild Singapore in 1986 and joined MiniScribe to transfer the 25 MB stepper motor drive from USA to Singapore for OEM IBM. Later the project was shelved and replaced by another hard drive for Apple. As things were not stable at MiniScribe, Katharine left to join Maxtor in the high capacity drive team in 1988. She did not imagine that in 1990, Maxtor bought MiniScribe and the merger was a mess. She then left to head the CSC Customer Service and Repair Center in 1991. In 2001, she

moved to Iomega to support all the post sales product services. She retired in 2002 when Iomega relocated their operations to China.

H S Ong joined MHSL in August 1984 as a process engineer reporting to Dax Kwoh in the Assembly Department. A year later, in September 1985, there was an opportunity to support second shift production at Fairchild Washington State, USA for two weeks. There was a need to ram up the production of SRAM for NASA. H S Ong readily agreed to seize the opportunity to travel overseas in a plane for the first time in his life at the age of 27. It was a first for him to drive an auto car and he had help from Carl Edwards, his counterpart in the USA. Carl also showed him how to use the snow scraper to clear snow on the windshield. "I was there to support the assembly operations from die saw to seal. I learnt to be very independent during my two week stay in America which eventually was extended to three months," recalled H S Ong.

Some of the colleagues H S Ong remembered were K M Chua, Ee Ah Seng, K H Ng, K W Yeo, Y C Chia and L A Lim. The group goes across to Lorong 5 Toa Payoh for lunch frequently and Ee Ah Seng would pull out a stack of $50 notes out of his waist pocket and foot the bill first.

H S Ong stayed a total of three years in Fairchild Singapore and left the company as a Senior Process Engineer in 1987. He was supporting the assembly area from die saw to hermetic seal. He was also involved in the solder conversion project where he worked with Dr Chan. He remembered the presentations to Bock Seng well, which had honed his presentation and thinking skills. "You need to be very careful with your numbers as well as what you say during the presentation," recalled H S Ong. He could never forget how crazy the semiconductor industry can be: Things change so fast. One quarter the company was employing people like crazy and the next quarter, employees were retrenched. Nevertheless, many people have worked in the semiconductor industry in general and Fairchild in particular. H S Ong is always amazed how often the people that he met would turn out to be ex-Fairchild employees.

Clayton Tan joined Fairchild Singapore in 1984 as a process engineer reporting to Stephen Ang in the backend department of MHSL. Clayton's most memorable experience was coming for work as "tearing staff" were leaving the front gate of the factory in Toa Payoh. He was to witness many more such retrenchment exercises as the factory re-organised repeated over

the next 5 years he was with the factory. Fellow team mates with Clayton were Aini, Wendy, Siti, Lawrence Koh and N H Lee in the Ceramic Operations. Clayton worked closely with the Failure Analysis Lab team, T H Chua and Pita as well as the Backend Plating team, Dr Chan and Susan to address the issues that surfaced from the backend operations.

A fresh graduate from NTI, Tham Siew Kuan joined as a test/product engineer in 1987 for the memory division under F M Liau who in turn reported to T K Tay. "I was the conductor for the Fairchild Choir for the 1987 National Day celebrations," recalled Tham fondly. He was asked by HR to help conduct the choir training just two weeks after joining the company.

CHAPTER 14

Digital Integrated Circuit Division

"These are commercial products packaged in plastic and manufactured in high volumes."

Fairchild Singapore was organised into three divisions in 1983 - the Aerospace & Defence (A&D) Division, the Memory & High Speed Logic (MHSL) Division and the Digital Integrated Circuit (DIC) Division.

"When I joined Fairchild in 1975, I reported to the very first DIC Assistant Manager, Lawrence Lee," recalled Pearlyn Tan. Lawrence was reporting to Don Spurling. When Lawrence left, Murphy Teo took over as the department head and I worked for him till 1986 when Tan Bock Seng became MD.

K Y Chan joined Fairchild Singapore with 12 classmates in 1977 immediately after graduating from the University of Singapore with an

engineering degree. He spent the next nine years in DIC Division first as a product engineer and later as the engineering manager.

K Y remembered those days where sending reports to the DIC headquarters in South Portland was such a laborious task versus today's email. "The report was first written by hand and then brought over to the telex room for the typist to convert it to telex format for sending electronically," said K Y. "Later the fax machine took over."

In 1978, K Y was sent to DIC headquarters in South Portland for three months to transfer test engineering knowhow to Singapore. "It was my first time on a plane," recalled KY. To him, the trip was torturous as it was a long journey over different time zones. Upon arrival, he was met by host Lemont Gagne who handed him the keys to a huge rental car. He was gracious enough to send K Y to the hotel when he realised that KY was taken aback by the sheer size of the left-hand drive American car. Nevertheless, K Y did try driving the car the next day but decided he was better off with a smaller compact car later.

In those days, the DIC products were tested using Sentry 100 testers. The noise from the test handlers was high with close to a hundred of them pounding away 24/7. K Y recalled that the noise level worsened after the old ceiling boards were repainted because they did not realise the paint had covered the minute sound-absorbing holes. "That's probably the reason why some of us suffer from high tone deafness in our later years," concluded K Y on hindsight.

The DIC business increased and the operations were soon moved to the new Building Two. K Y remembered that rain water leaked into the new assembly clean room after a heavy downpour one weekend. "We did not realise that rain water was swirling under the raised floor boards until someone decided to take a look underneath," said K Y. The team swung into recovery mode immediately to clear the water before production the following day. "I enjoyed the team spirit then and we had time to play games after work," remarked K Y fondly. "The football, bowling and other social events helped improve communications and built team work."

H K Sim joined DIC Engineering in 1980 when Harry Van Wickle was the MD. He spent five years with the company before leaving in 1984. There was another H K Sim who was in production control. "My name is always mixed up with his," recalls H K and so he added (E) to his initials to

indicate he is from engineering – H K Sim (E). "Fairchild was a good company to start with. There were a lot of career and personal skills training. Fresh from Singapore University, my job in product engineering was to perform failure analysis and yield improvement," added H K Sim.

Eddy Tang was the process engineer in the DIC Division working with Joe Koh, Nicholas Liew, K B Yeoh in engineering and Michael Tang in manufacturing.

C C Foong joined Fairchild Singapore on October 1983. He started with the automation group in DIC Division under V F Ong. His initial assignment for six months, from December 1983, was to work in South Portland with Arthur Woodward's team on the MCT auto-test program generation software to be implemented in Singapore. Test programs at that time were hand coded by test programmers which is prone to errors, both syntax errors as well as logic errors. The test programming team in DIC was led by H K Sim (E). The automatic test program generator (ATPG) allowed the test engineer to focus on designing the test logic and let the software generate a syntactically correct test program that would compile error free every time. The time taken to hand code a tet program could be as long as several days to a week. The ATPG could get this done in seconds. In addition, there is also built-in intelligence about tester characteristics and testing methodology. To put it simply, the engineer had to merely define the device pin configuration and functions, the test patterns to be used in the test, functional and parametric test conditions and the ATPG would then spit out the correct test program code, including the proper pin conditioning and test set up sequence.

To further drive down the cost of testing the devices, the company embarked on a project to develop the MCT dual-site testing program. Prior to this, the devices were indexed sequentially resulting in the test system having to wait for the next device to be indexed into the test site. The dual-site testing approach helped the company maximize the use of the very expensive testers and increased throughput by eliminating the delay due to indexing time. C C Foong spent another six months working with the same South Portland team to develop this before he was transferred to the design group.

CHAPTER 15

Design Centre

"The IC design centre was first conceived in 1983."

The Fairchild Design Centre was one of the very first IC Design technology initiatives in Singapore. Although the design centre was closed shortly after National Semiconductor bought over Fairchild, the core group of engineers and technicians continued their careers and contributions in other IC Design projects in Singapore.

The initial investment for the IC design centre was S$6.8 million, including training costs. The company hoped that it would generate revenues of more than S$50 million a year from this newly created design centre.

The push for the design centre was for more investment allowance from EDB. Mike Morrissette, then MD of Fairchild Singapore and KY Chan, the Operations Manager of the DIC Division, worked with EDB to pull together the design centre project. EDB offered Fairchild Singapore a tax allowance of up to 50 per cent on the equipment for the design centre and 40 per cent tax relief on the company's operations in Singapore.

K Y Chan was quoted in the Straits Times (28 January 1986) saying that the reason Fairchild Singapore was chosen to start the centre was because of its 15 years of experience in the assembly and testing of

semiconductor products. "The Government's emphasis on high-technology and the support from EDB were the other factors," he said.

"The design centre, which is the first in Asia for Fairchild, will mainly cater to the United States market and later to the Asian market as it develops further," added K Y Chan. The centre was equipped with the latest state-of-the art tools for design. "The company's continued support for the design centre, despite the big recession in 1985, demonstrates its commitment to be the best in customer support and service, and to provide high-performance, high-speed and high-technology products to the semiconductors' market," said K Y.

A training programme was prepared to train Singaporean engineers to man the centre. The company was reported to have spent $1.3 million to train a total of ten engineers. The engineers attended integrated design courses at MIT and Stanford University. In addition, in-house training was given. The plan was to have a total of 12 engineers that will produce 10 to 12 IC designs a year when fully operational. It would also employ six technicians as support staff.

The first design centre manager was S Y Tan. She was recruited by K Y Chan and Heng Liang Eng. A native of Malaysia's state of Sarawak, S Y holds a Bachelor of Engineering and an MSEE from the University of Saskatchewan in Canada. She did graduate work at MIT as a Fellow in the Centre for Advanced Engineering Study. After three years of training in DIC Headquarters in South Portland, Maine, from 1983 to 1986, she returned to become the design centre manager reporting to Nicholas Liew and V F Ong.

The core group included IC designers, IC layout, Prototype testing and design system support engineers and technicians. The IC designers were Eric Goh Sian Ee, Dr. Peter Loo, Ravi, Tony Tsai, Tham Siew Kuan, Peter Foo, Kenneth Tan, Thomas Heng and Tony Hsu. The Design Characterization Lab team were Eddy Tang, Tan Bee Hong and Choo. The layout team was headed by Toh Geok Tin with Ang Kwang Shan and Siaw Kah Nee reporting to her. The systems team were C C Foong, Leong Mun Wai. Some of the others were Leow Soon Siong and K H Chu.

The design centre was located on the third floor in the DIC building. Entry was restricted to the design centre staff. The half glass walls gave a good view of the spacious centre furnished with expensive ergonomic

Herman Miller furniture from France. As a result, the place was also referred to informally as the "gold-fish tank".

Tham Siew Kuan was one of the second batch of engineers recruited into the IC Design team. The second batch was recruited from internal staff to replace some of the engineers in the first batch who had left. Tham recalled the day he joined the HR people for lunch and S Y Tan happened to be there. "I asked S Y if the closing date for the internal recruitment was over," recalled Tham. She said yes and followed with a question "Why do you ask?" SY then invited Tham to visit the design centre. Little did he realise that it turned out to be an interview and he was not prepared for the technical questions S Y threw at him. This was followed by an interview with Nicholas Liew, the Department Head for the Design Centre. "Nicholas asked me for the reasons for wanting to join the IC Design Team. He pretty direct and told me straight that he was not satisfied with my answer that I was interested in IC Design." For a while, Tham thought that was the end of his hopes of joining the team until that evening, he bumped into S Y Tan while leaving the factory. "She told me that I got the job!" said Tham who still had vivid memories of that fateful day.

The design centre was working on custom TTL designs such as fast-switching TTL flip-flops. They used Mentor Graphics tool for the transistor-level TTL designs and SPICE for the simulation tool. "We were a bunch of close, cohesive, great and supportive team under the watchful eyes of S Y Tan," said Tham.

Eddy Tang's role in the design centre was product characterization which basically tracks the product performance across voltage and temperature. He had applied for the position when there was internal posting of job openings in the Design Centre.

Soon after the acquisition of Fairchild by National Semiconductor in 1987, there were rumours of possible re-organisation/layoffs. Tham remembered that the production people were commenting that the people in the "gold-fish tank" should be safe as National Semiconductor Singapore did not have such a facility. "We did notice S Y and Nicholas were busy in discussions before but the announcement to us of the decision to shut down the design centre came as a surprise," said Tham who remembered that the announcement came exactly a year after the acquisition by National Semiconductor.

"We were gathered in the room and Bock Seng commented that he had tried very hard to keep the design centre going and had no part in the final decision to shut it down," recalled Tham. Bock Seng also added that he wished to absorb the team into production but did not think that they would stay. So he thought that it would be best if the team at least get some layoff benefits while the company and EDB would help them look for alternative employment. Nevertheless, he did assure the team that if any of them should want to stay on with the company, they would absorb them. "That really helped to soften the blow for us knowing that the management still cared," recalled Tham.

As the news sank in, the team was quiet for the rest of the day. The team was asked to finish their remaining tasks as professional as possible, archive them before transferring the jobs back to Maine within a month. The team left in two groups. Peter Loo, Eric Goh, Eddy Tang, C C Foong, Toh Geok Tin, S S Leow, Seow Kah Nee, Ang Kwang Shan, Tan Bee Hong and S Y Tan left for Chartered Semiconductor which was later spun off into TriTech Microelectronics Limited. Tham Siew Kuan, Kenneth Tan, Leong Mun Wai, Oh Huan Khoon and Thomas Heng joined AT&T.

At the final outing, Bock Seng was given a gift by the team in appreciation of his efforts to help resettle them. He was reported to have said, "This is the first time that I've been given thank you notes, let alone receiving a gift, by the very people whom I am laying off."

G T Toh joined Fairchild Singapore as a CMOS/TTL DIC product technician in 1997 immediately after graduating from Singapore Polytechnic. She was reporting to K F Woo. In 1983, she was granted a Fairchild Scholarship to pursue a degree in electrical and electronics engineering at NTI (now NTU). G T returned to Fairchild as a product engineer upon graduation in 1986. A year later, S Y Tan asked her to join the design team as an IC Mask Design Engineer.

G T Toh was sent to South Portland, Maine in the US for three months to learn about IC mask design using Mentor Graphics layout and Dracula verification tools. "When I stepped out of the airport, I was delighted to see and feel the light snowflakes falling on me for the first time," recalled G T fondly of the trip to South Portland. "The others in the team were laughing at me for not having seen snow before."

G T was grateful to Fairchild for sponsoring her undergraduate studies as well as the opportunity to be trained in IC mask design. Today she is still contributing to the design community as an IC layout design manager at Marvell Asia Private Limited.

C C Foong spent one year with the DIC automation group before joining the design team. "The Singapore design facility, although small in size in terms of headcount and equipment, was quite comprehensive," recalled C C Foong. Initially there were two Mentor Graphics Idea Stations for schematic capture and Spice simulation. These were state-of-the-art at that time. Later more and newer systems were added to support the physical layout activities, including a VAX computer for running bigger simulations and for design rule verification. There was also a failure analysis station which was made available for training product engineers to do effective failure analysis work. "When the group disbanded, the major beneficiary was Singapore Technologies who ended up having a group of very well trained staff working for them," added C C Foong.

Eric Goh joined Fairchild Singapore in 1984 fresh after graduation. He started as a product manager taking care of 64K Bi-Polar PROM in the MHSL Division. About a year later, he was selected by K Y Chan for a two-year IC Design training in South Portland, Maine. "I am eternally grateful to K Y," said Eric Goh. "It was an opportunity of a lifetime."

During the two-year assignment in Maine, one of his trainers was Geoff Harlington. "Geoff was a gentleman who was willing to share his knowledge," said Eric Goh. "I learned and benefitted a lot from Geoff." While in Maine, Eric Goh did two re-designs and subsequently did one complete design, the M014. One of the re-designs was to fix some problems in the M384 product.

Upon completion of the training, Eric Goh returned to the Singapore Design Centre reporting to S Y Tan, who in turn was reporting to Nicholas Liew. One of the immediate tasks of the returning designers was to train the local engineers to become designers.

Tan Bee Hong joined the Fairchild Design Centre in 1987 to help set up the Design Characterization Lab. Reporting to Eddy Tang, she was responsible for lab automation development, devices characterization and design failure analysis. "Together with the designers, we were posted to Fairchild Design Centre in Maine," said Bee Hong. "We had a great time

there as the pioneer team. Unfortunately, some of them left shortly after they came back to Singapore."

CHAPTER 16

Ceramic Operations

"The Fairchild Singapore operations were consolidated into Ceramic Products and Plastic Products."

In 1986, the Fairchild Singapore operations was consolidated into Ceramic Products and Plastic Products with quality taken out to become a central function. As a result of this re-organisation, F T Liu, N J Wong and Desmond Tan reported to K C Lau for the ceramic backend operations which now included the products from Aerospace & Defence Division as well as the Memory and High-Speed Logic Division.

By June 1986, F T Liu was transferred to the Ceramic Assembly Operations reporting to senior process engineer K H Ng. In turn, K H Ng reported to Dax Kwoh, engineering manager reporting to Paul Lones.

F T Liu's responsibility was to improve and sustain the bond yield as well as perform data analysis of the third optical process. Another engineer, L A Lim was responsible for the die saw and die attach process. He was reporting to another senior process engineer, H S Ong.

The third optical process involved visual inspection under 30X of the assembled units just they were released for encapsulation. Each operator is

given a pair of tweezers, gloves and a 30X Olympus microscope. The units come in stainless steel carriers with 5 carriers per container.

The pareto analysis of the defects at third optical indicated that bond defects were the highest – smashed bonds and missing bonds. This was unusual as the machine capability of the Shinkawa US10 bonders were 99.9%. The Japanese engineer from Shinkawa based in Singapore was called in to conduct training on the machines and to understand what the reasons for the high defect rates were. It was a fruitful session as we discovered that many of the bond defects were due to the die attach issues. When the die is titled, it causes smashed bonds. When the die is not mounted in the centre of the cavity and outside of the wire bonding window, it resulted in missing bonds. The operators were then trained to reflect die attach problems so that the root cause of the bond defects were addressed. Immediately the bond yield improved but the die attach yield dropped and put a lot of pressure on L A Lim.

In order to improve the yield further, a proposal was put up to go to Shinkawa Japan for advanced training on how to improve the operating window so that the bonding process was less sensitive to the quality of the incoming materials from die attach. The proposal put up by F T Liu was approved by Paul Lones. At that time, Wan Choong Hoe came with an offer to transfer him to in-quality quality to work with suppliers to eliminate all in-coming inspection which was a major cost centre. Eventually, F T Liu took up the offer and L A Lim was sent to Shinkawa Japan instead. H S Ong remembered that he was asked to approve a $100 lunch expense when L A Lim came back. At that time, the yen was very strong versus the Singapore dollar and meals in Japan were that expensive!

Meanwhile, N J Wong who was in the Backend Operations Process Engineering Group was working closely with Lawrence Koh. N J Wong was able to learn more from Lawrence than before due to the latter's many years of experience in the Test and Finish area.

Since Lawrence Koh was a vegetarian, N J Wong, his lunch partner, was introduced to many vegetarian restaurants around Toa Payoh. The vegetarian restaurants were usually helmed by Hong Kong Chefs and the food was incredibly tasty. "I also learnt from Lawrence that there are some Chinese Temples in Singapore that served free vegetarian food to the public on the first and fifteenth of each lunar month," recalled N J Wong.

"Although we ate the free lunches, Lawrence always made a generous donation to the temple coffers."

As a result of the consolidation, and the uncertainties surrounding Fairchild's future, a lot of new staff were leaving the company for greener pastures. Desmond Tan, for example, resigned soon after to join AT&T. Older employees who have been with the company since the 70's were waiting to be retrenched to claim their retrenchment benefits equivalent to one month's pay for each year of service. It was not a great environment to work in and morale was low. There were rumours about Fairchild being sold and constant talk about retrenchments. "We had super long lunches (two hours) and tea breaks (1 hour). Tea and coffee was a mere 20 cents in the company canteen! It was through these sessions that I got to learn more about the person behind the colleague," said N J Wong.

N J Wong learnt about life after Fairchild from the canteen talks. "H L Kor mentioned that he would go into the food business while someone else mentioned doing elder-care centres to take care of the aged like the retirement villages in America," said N J Wong. "Even back in 1987, they were already cognizant of the fact that the Singapore population was aging rapidly." Many of the managers went to join the new hard disk drive companies like Seagate, Maxtor, Quantum and Conner Peripherals. One of them was H W Tan who joined Seagate.

N J Wong was asked to go for an interview at Seagate by H W Tan some time in mid-1987. "When I arrived at Seagate in Kallang after 6 pm for the interview, I saw many ex-Fairchild employees there," recalled N J Wong. "Although I was offered a similar job as what I was doing in Fairchild, I thought it would be a good change of environment. Besides, Seagate was growing and I was offered a higher salary. Finally, my resume would look good with additional hard disk drive manufacturing experience," thought N J Wong.

The following day, N J Wong tendered his resignation and F T Liu got to know about it and approached him that very day to offer him a position as QA Engineering Assistant. By then, F T Liu has been promoted to become the QA Manager in the Plastic Operations reporting to Wan Choong Hoe. "He would rather work with me than to take a risk with a new hire," recalled N J Wong of the conversation with F T. "I must admit that F T was very persuasive and convinced me that by joining his team, I

would have a change of environment and doing something new. I would also not lose my friends in Fairchild." F T Liu dispelled all of N J Wong's misgivings by exceeding Seagate's salary offer.

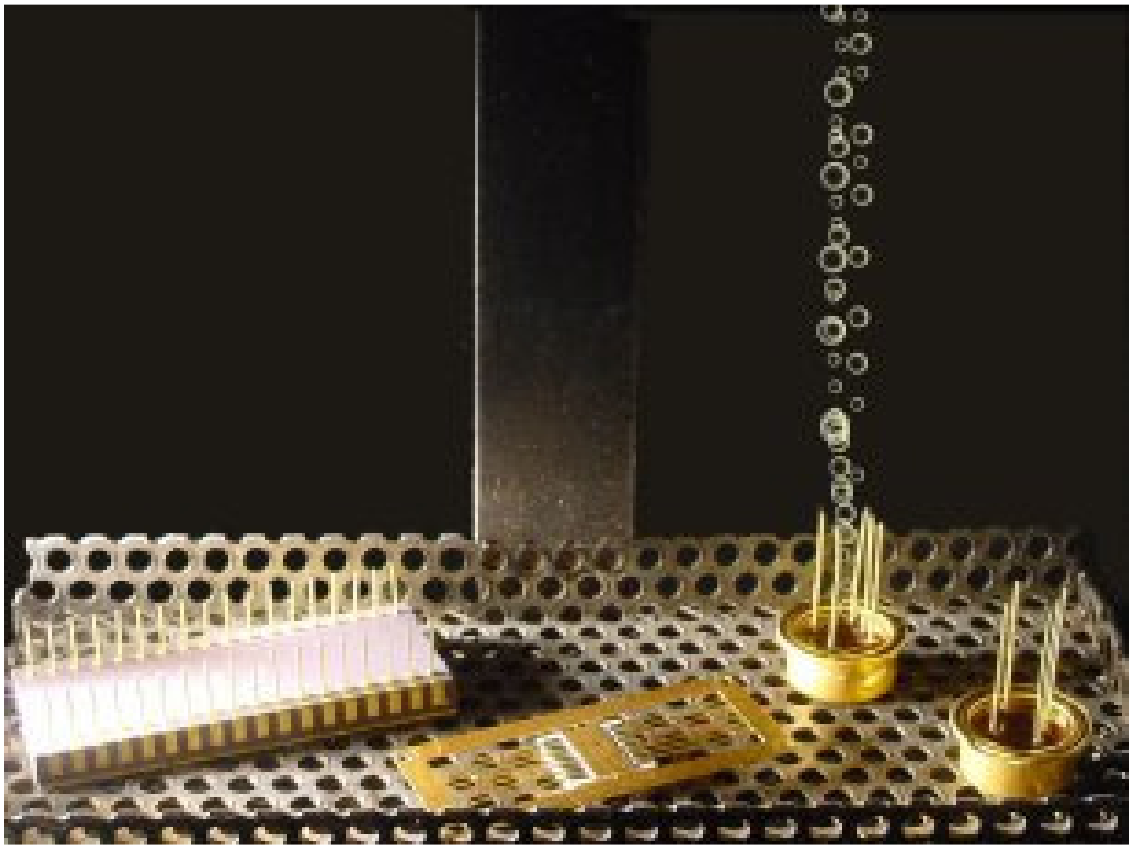
FOTON Model 8030 Die Bonder

Shinkawa US10 Wire Bonder

Luke Goh joined Fairchild Singapore in August 1988 as a process engineer in the backend operations. He worked for C P Sue and fellow colleague, Jimmy Oo was his mentor. "Jimmy was a cool guy who taught me about the hermetic operations where we did fine and gross leak testing," recalled Luke Goh. "That was where I learnt problem solving and honed my skills in trouble shooting." As radiation gas, Krypton-87 was used for fine leak detection, Luke Goh was initially worried about handling the calibration that was performed every 30 days to calculate the half-life. "I was worried until I noticed that some operators working in this area were pregnant. That was a great relief!" said Luke Goh.

Seal integrity testing is crucial for hermetic packages in military, space and commercial applications. A loss of hermeticity is a reliability concern and will allow moisture and contaminants to enter the package cavity thus shortening device lifetime. The devices for fine leak test are first preconditioned in a pressurized chamber for a given period of time. Then the leak rate is measured and recorded, applying a pass/fail criteria.

A device presenting a gross leak could theoretically pass the fine leak test. Therefore, this test is typically performed after the fine leak test. The gross leak test is based on boiling points differential of two fluorocarbons. The device is first preconditioned in a pressurized chamber filled with a low boiling fluorocarbon (the Detector). Under pressure, the Detector fluid may penetrate the device. The device is then submerged in a second fluorocarbon fluid with a higher boiling point (the Indicator). When exposed to the high temperature, the Detector fluid located within the cavity of the package boils, causing a bubble stream to emanate from the leak site.



Gross Leak Testing

Luke Goh also remembered well the "Bock Seng" lots. There were urgent and important lots where the MD gets involved. The whole production line would be abuzz and watch out for such lots and all engineers would also be on standby to resolve any issues so that the lot can ship out. Luke Goh remembered one package that was meant for the F16 fighter planes in America which went for US$1,600 per piece. There were also some Leadless Chip Carriers (LCC) that were meant for the Patriot Missiles.

Luke Goh remembers clearly the "Face Reality" caption in Bock Seng's room where the team went in with trepidation for meetings. No one asked why when it was taken down on day. Luke Goh left the plant in 2005 when National Semiconductor was rumoured to be closing down the Toa Payoh factory. He left to join the other former Fairchild colleagues at StatsChippac.

CHAPTER 17

Quality & Reliability Division

"K W Sin was the first head of quality."

THe first head of quality was K W Sin, transferred over from Fairchild Hong Kong in 1969 to help start the Fairchild Singapore operations. Later C E Tan took over and eventually Lee Wah Kee became the head of Quality and Reliability. When Bock Seng came over, Wah Kee left to join Conners. Wan Choon Hoe then came over from TI Singapore and took over the head of Quality position.

Lee Wah Kee joined Fairchild Singapore on 2 June 1969. Prior to that, he worked in Singapore Oxygen and Hume Industries. The latter was manufacturing asbestos. "I was glad to move from the dirty heavy industry to the semiconductor light industry," said Wah Kee. He had applied for a production supervisor position but was offered a position as quality engineer reporting to K W Yao. K W Yao in turn was reporting to K W Sin, the head of quality at Fairchild Singapore.

Wah Kee started his work at the temporary site in Lorong 1 before moving over to the new Fairchild building at Lorong 3. The operations were the assembly of ceramic DIPs which were then sent to the States for test and finish.

When K W Yao left Fairchild in 1972, Wah Kee reported directly to K W Sin as the QA Section Manager for Ceramic and Plastic DIP products. In those days, the Ceramic DIP products were mainly for USA military contractors like Unisys. In order to assure that the manufacturers in the Far East are doing the right thing, these customers would have source inspectors sent over to audit the facility. It was Wah Kee's job as the QA Section Manager to take care of these source inspectors. "And if they are not well taken care of, they can make life difficult for you," said Wah Kee. "We not only took them out for dinner but also arrange outings for them. Fishing was one of the favourite as Murphy enjoyed it."

Indeed, that was what happened when the Unisys Source Inspector, for some reason, wrote a nasty report to the Fairchild Corporate office after his visit to the Singapore facility. As a result, there was a re-organisation in 1978. The HIREL department was formed and headed by Lawrence Lee and Tan Chip Eng, who was then the Engineering Manager, took over from K W Sin and became Wah Kee's new boss for the next three years.

Another major re-organisation happened in 1981 when H B Chan became the General Manager of the Fairchild Singapore facility reporting to the Managing Director. Chip Eng decided to leave the company and Wah Kee took over the Plant QA responsibility reporting to H B Chan.

Wah Kee's entire career in Fairchild Singapore was in the quality area. When he started work in Fairchild in 1969, the quality awareness in Singapore had just started. SISIR initiated the PQR (Productivity, Quality & Reliability) Campaign and offered a basic quality course for the industry. "That was the only formal quality training I had," recalled Wah Kee. "The production people were not quality conscious. They just followed procedures. The Quality and Production Departments were often at loggerheads." In the 1980's, the Government began to raise the quality awareness across the nation due to the impact of Japanese quality. The Total Quality Control movement was launched and manufacturing organisations like Fairchild Singapore began to form quality control circles

(QCC). The whole nation was trying to catch up. As a result, there was more cooperation between Quality and Production Departments.

The Straits Times (2 October 1981) reported the visit by American QC Specialist Wayne Ricker who was in Singapore to help in the extension of the QC circle programme which was started in January 1981. Fairchild was reported to have saved between $25,000 to $30,000 every month through an idea proposed by one such QC Circle.

Fairchild Singapore was also reported to have sent 2 representatives to the 2nd International Quality Control Circle convention in Tokyo from September 30 to October 2, 1981. One of the QCC teams from Fairchild Singapore, Harmony, was selected to present at the National Quality Control Circle Convention held in November 1982.

Apart from the Quality Movement that swept the nation, Wah Kee remembered the Union movement. "There was a period when the MD (probably Bill Watson) was away and a group of management staff went to NTUC and asked to form a management union. They got the support of NTUC!" said Wah Kee. As a result, the management split into two groups – one that joined the union and the rest who did not join. "There was so much politics going on that period that we hardly did any work," recalled Wah Kee. When the Fairchild Corporate office heard about this, they threatened to shut down the plant in Singapore. This effectively put an end to all the management union activities. "I suspect the Government stepped in," said Wah Kee.

The other significant event Wah Kee remembered was having to host Dr Tony Tan who was the VIP for the National Day Celebrations in the plant. "The MD was away and I was asked to be the acting MD. It was raining that day and the celebrations were held in the canteen," recalled Wah Kee.

In 1986, when Tan Bock Seng joined Fairchild Singapore as the local MD, Wah Kee's QA organisation consisted of the following:

- A L Tan, who was responsible for IQA (Incoming Quality Assurance). This group was responsible for the quality of the raw materials. M Osman was part of this group.

- Robert Chew, who was responsible for process quality. This involved implementing total quality management practices across the company.
- T H Chua, who was responsible for reliability assurance.
- H S Teo, who was responsible for the Plastic Products, and
- H B Ng, who was responsible for the Ceramic Products. Under H B Ng, were Lawrence Lim for A&D Quality, Y Y Lee for MHSL Quality.

Problems with Bock Seng first surfaced with A L Tan due to the issue of white spots found on the lead frames for the Plastic DIP products. This issue had a major impact on the assembly yield in DIC. In one of the meetings in Bock Seng's room to address the issue, A L Tan was reported to have declared, "If I know anyone who can solve this white spot problem, I will hire him." This obviously did not go down well with Bock Seng. "He came to see me and asked me to let A L Tan go," recalled Wah Kee. "I asked Bock Seng for some time and said I would monitor A L Tan weekly." But Bock Seng would not accept the fact that a manager needed to be "monitored weekly". And so A L Tan had to go. The news came as a shock to A L Tan who told Philip Low, the HR Manager, that he would get his lawyers to sue the company for wrongful dismissal. But he had no case as the employee contract clearly allowed each party to give notice to each other to terminate the employment. Finally, A L Tan came back to Fairchild to collect his severance pay and the case closed.

Robert Chew was the next person that had to leave due to differences in how the quality process should be carried out in the company. K W Sin, the Safety Office and Willie Chan, who was heading facilities, suffered the same fate.

Wah Kee saw the writing on the wall and resigned two months later. Bock Seng did not try to keep him but instead instructed Philip Low from HR to call Wan Choong Hoe over from TI Singapore. "He already had a list of names ready to replace those who left," recalled Wah Kee. "Bock Seng was right when he told me that those who were asked to leave were

not necessary incompetent, just that they could not fit into the direction of the company," recalled Wah Kee. "Many like K Y Lim left Fairchild and did well to become the MD of Adaptec Singapore."

Wah Kee left Fairchild Singapore in 1986 to join Maxtor. K W Chin who was with Fairchild Industrial Engineering was already there as the manufacturing manager. "It was good working with a former Fairchild colleague at Maxtor," said Wah Kee.

When H B Chan started Conner Peripherals, Wah Kee was asked to come over to head the quality department. "Quality demands in the hard disk environment are many times that of the semiconductor," recalled Wah Kee, "Life was much tougher than in semiconductors." When Seagate bought Conners, Wah Kee left to start his own consultancy for a year. "It was difficult to start your own business," said Wah Kee. He then went back to work for UIC PCB Assembly operations in Batam. When H B Chan started IBM Storage Division in Singapore, Wah Kee left UIC to join him, but not before recommending a former Fairchild colleague, Dax Kwoh, to take over his position in Batam.

Wah Kee retired from IBM in 2000. "I was too contented in Fairchild Singapore and spent 17 years there," reflected Wah Kee. "When I joined the hard disk industry, they issued stock options which allowed the staff sufficient money to buy houses for investments. I was like a frog in a well. On hindsight, I should have left Fairchild earlier. Must thank Bock Seng for it."

K C Liang, batch number S118, joined Fairchild Singapore in 1969 in Ceramic production operations reporting to Superintendent George, who soon left to become a lecturer. S S Leong was overall in charge of the Ceramic Operations.

Two years later, in 1971, K C Liang joined QA reporting to Wah Kee. "Quality became the focus in the 70's and I was attracted," recalled K C Liang. As the bonders were still manual, one of the tasks of K C Liang at that time was to catch bond short failures. "There were some problem Supervisors like Herman Alvin (a Eurasian) who said that bond short can be accepted," recalled K C Liang. "It was then that only lots with the QA stamp could be released for testing."

When T S Low of IQA left, K C Liang was transferred over but still reporting to C E Tan. "I still remembered on day H B Chan called up C E

Tan, who was in the US, and told him that he is now taking care of MAPICS," said K C Liang. "After that, Wah Kee took over QA."

Some of K C Liang's most enjoyable times was going to Jakarta to support the operations there. "I was there more than 10 times when Harry van Wickle was the MD," said K C Liang. In 1981, K C Liang was promoted to Senior Q A Engineer. He left Fairchild Singapore a year later in 1982.

T H Chua joined Fairchild Singapore in August 1978. Harry van Wickle was the MD. TH Chua spent almost 7 years in the reliability department. There was frequent shifting of the office from S1 to S2 and back. During those years, TH Chua saw the localization of the heads of departments and felt that Fairchild did well in this aspect.

The other nice thing he remembered was the regular salary adjustment for engineers as the tight labor market drove up salaries in Singapore.

Fiona Fan joined Fairchild Singapore in 1982. She was hired by H T Ong who in turn reported to Lee Wah Kee the head of QA at the time. Fiona worked in the calibration lab and her job was to perform the calibration of all the electronic equipment used in the company. This was an important task as any deviation of the equipment will result in either false reject of the devices or false acceptance. Fiona left the company in 1988. She remembered colleagues like M Osman, Sock Eng, Koon Mei, Lim Hock Guan and Thomas Heng. "Osman had a small red car with a sticker that says "One day, I am going to be a Mercedes," said Fiona. "The Annual Dinner & Dance was something we all looked forward to as well as the tea breaks at the cafeteria listening to the jokes from F T Liu."

Tan Cher Ming joined Fairchild Singapore in 1984 as the Failure Analysis Engineer reporting to T H Chua. One of the major issues at that time was bond pad corrosion due to solder flux seeping through the interface between the mold compound and the leadframe during the tin plating operation. The failures were detected at the Pressure Cooker Test (PCT) and the Temperature Humidity Bias (THB) Test. PCT is conducted to assess the ability of a device to withstand severe temperature and humidity conditions. It is used primarily to accelerate corrosion in the metal parts of the product. THB test conditions involved soaking the device at 85 deg C and 85% relative humidity for 1,000 hours to accelerate

metal corrosion, particularly that of the metallization on the die surface of the device. Cher Ming was working with Dr Chan to resolve the problem. He did some modelling on the moisture penetration while Dr. Chan successfully developed a non-corrosive flux to eliminate the problem. Cher Ming left Fairchild in 1986 to pursue his further studies. Today he is an Associate Professor in the School of Electrical and Electronics Engineering at NTU.

In January 1987, F T Liu was transferred to the incoming quality department reporting to M Osman. He was reporting to Wan Choong Hoe who was the head of quality. Wan was brought in by Bock Seng and took over the job from Lee Wah Kee. The task was to eliminate the incoming quality inspection in line with the Japanese concept of total quality management. An entire department was set up to do mold flow to quality mold compound from Nitto; tensile testing to qualify the gold and aluminium wires from Tanaka Electronics and American Fine Wire; drop tests to quality the ceramic substrates from Kyocera and NGK. The framework was put in place to qualify the supplier for skip lot inspection as a start leading to total elimination of the incoming inspection.

After six months, in June 1987, F T Liu was again transferred to take over Maung Myint Swee's Quality Manager position in the Plastic Operations. He was in turn moved over to become the engineering manager taking over from Ne Win Ma. The latter took over Wan's position as head of quality. Wan had vacated this post to take over Paul Lones as head of the Ceramic Operations.

Myint Swee had two lady QA Engineers reporting to him as well as three QA Supervisors and 36 QA inspectors. The two QA Engineers happen to be F T Liu's seniors in the university and it became a problem for these two EE graduates reporting to an ME graduate. One of them asked for an immediate transfer to product engineering while the other resigned shortly.

Goh Seng Chong, Veronica and S Y Loke were hired to take over their jobs with Seng Chong responsible for the non electrical items and Veronica and S Y Loke the electrical test area. The three supervisors were K Y Lee, S P Lee and Seetoh. The latter was running permanent night shift. N J Wong joined soon after as the QA Engineering Assistant. There were

also two QA Operators, Josephine Ho and Jamilah. Noriah was the QA Clerk.

The head of the plastic operations by then was Tan Ka Huat. He brought a number of TI Singapore folks over and it soon led to an exodus of the original Fairchild staff.

S Y Loke was quite a character as he spoke with a very strange accent. A Malaysian who graduated from local university, NTI, S Y Loke was very into computers. "Regardless of the area of specialization in computing, all programs will ultimately have to handle data of some form. Therefore a strong knowledge of databases will prove invaluable if one wants to be a computer programmer." S Y Loke once told N J Wong. Indeed, when N J Wong became a full time software developer later in life, his expertise and knowledge in databases truly helped him in his career.

N J Wong attended a Juran Quality Control course conducted by Simon Foo, an external consultant and found the subject of statistical quality control very interesting. He would subsequently learn about the other quality titan, William Edwards Deming, credited as the American who taught the Japanese about quality.

One of the major tasks was to shut down the Fairchild Nagasaki plant and transfer the products over to Singapore. As QA Manager of the Plastic Operations, F T Liu was sent over to Japan to effect the qualification process. When he returned, he was full of praise for the quality standards that each Japanese operator imbued in their job.

For example, in the clean room, because of the use of lint free paper and the gloves used, the Lot Traveller that comes out of the clean room is almost illegible. However, in Japan, all operators had to undergo writing lessons in cleanroom garb. The Lot Travellers that F T brought back from Japan were in pristine condition and the writing was legible.

Another example was the packing area. The boxes that F T brought back were sealed with conductive tape and printed labels attached to both ends. The tapes on each box were of identical length and the printed labels were positioned centrally on the ends of the box. In Singapore, the tapes were of varying lengths and the labels were slapped on without regard to their orientation. "A conscientious awareness of doing quality work is something I strive for event to this day," said N J Wong.

One of the tasks in the QA department was answering customer complaints. By then, emails were sent via VAX computers from DEC and no longer IBM Mainframes. The VAX computers also allowed for real time messaging between Singapore and South Portland. Our QA counterparts were Nick D Aquila, Wayne Orf, Mike Dube, Ron Morneault, John Littlefield, and Martin Feeney. "Thinking back, I really marvel at how I gave the most preposterous of explanations to some totally in excusable manufacturing lapses," recalled N J Wong. "We had customer returns which when X-rayed displayed no dies inside! These were clearly sabotage by some unhappy staff in production as each unit goes through three tests at hot, room and cold temperatures."

QA was also not spared the need for productivity improvement. A project, called Random Unit Buyoff (RUBY) was kicked off to reduce the time taken by QA to release the lot due to the need for samples to go through QA Test. Normally, a tester is set up with a production test program that stresses each chip at very tight specification limits. After the lot has been completely tested, it is placed at the outgoing area. A QA Operator will then pick random samples from these materials for QA Buyoff. The samples are tested using QA Programs which has less stringent limits. If any sample units failed, the entire lot has to be retested and the failed units sent for failure analysis by the test engineers.

Picking samples and changing tester setup from Production Test to QA Test takes time. In RUBY, the idea was to have a hybrid program that will randomly select units to be tested to QA limits after the Production test is completed. One of the problems with this approach was that the QA Sampling was no longer subjected to additional handling forces as the same chip seated on the test board is selected to be tested to QA limits after the production test. This is all done by software. As a result, "walking wounded" units would not be detected.

Through this project, N J Wong had a chance to work with the Automation Group, Goh Kim Siew and Nancy Tan. Kim Siew left Fairchild to join Conner Peripherals in 1988. In November, he offered N J Wong a position in the IT department in Conner Peripherals. Although F T was reluctant to let N J go, he knew that NJ had always wanted to do programming and sent him off with his blessings. N J Wong left Fairchild in December 1988 after a memorable three years.

National Semiconductor acquired Fairchild in 1987 and the Singapore operations had to give up the assembly of the Plastic DIP products to the Penang plant. The operations was re-organised as Standard Ceramic and Mil-Aero products in 1989.

CHAPTER 18

Mil-Aero Division

"These consist of products from Fairchild and National Semiconductor."

With the shutdown of the National Semiconductor operations in Lower Delta and the consolidation in the former Fairchild site in Lorong 3, Toa Payoh, there was a need to move the team around.

F T Liu was transferred from QA Manager of Plastic Operations to become the Production Section Manager in the Mil-Aero assembly cleanroom operations reporting to D Vasoo. As a result of the consolidation, the operators consisted of those from National Semiconductor and Fairchild. It was a nightmare for the previous production manager to get things going. There were yield problems and people problems. These were straightened out within one year.

CHAPTER 19

Standard Ceramic Division

"These consist of products from Fairchild and National Semiconductor."

With the transfer of the Plastic DIP products to Penang, the Singapore team was tasked to take over the Standard Ceramic Operations. This was headed by Tan Ka Huat, formerly head of the Plastic Operations.

In order to strengthen the former plastic team who has now taken over the standard ceramic operations, F T Liu was transferred over from D Vasoo to report to Mike Tang. F T Liu was assigned the backend operations as well as a new Single-In-Line Module product from National Semiconductor. This involved surface mount reflow process.

The team consisted of CH Cheng, S K Yeo, B M Hoo, Angela Mak, Francis Steven and David Ho together with 136 operators. S K Yeo was to be retrenched and get a nice package for his many years of service. However, he requested to stay on and we allowed it. However, it may not have been a wise decision on his part as Michael Tang was not the easiest people to work under as Supervisors and they had a hard time daily. As a result, S K Yeo smoked quite a bit. He passed away several years ago.

When Chua Mui Koon left the company, the assembly cleanroom operations were consolidated under F T Liu. Four supervisors, BY Teo,

PK Lee, Kelly Choo and Elsie Chook together with 158 operators came along.

CHAPTER 20

Plastic Leaded Chip Carriers Division

"These consist of products from National Semiconductor."

With the complete shutdown of the Lower Delta operations, a new division was set up to assemble and test the Plastic Leaded Chip Carriers (PLCC). This division was headed by K T Tan and his team which was entirely from National Semiconductor.

To ensure the successful integration of this team into Toa Payoh, F T Liu together with four of his supervisors were transferred over to manage the backend and final pack operations. This includes tape and reel and visual/mechanical inspection and customer finishing before shipment.

F T Liu reported to David Tan, the Manufacturing Manager in January 1990. It was interesting to see a totally different culture – one which is less process driven and more people oriented. However, from the operations point of view, this posed serious problems as processes breakdown. One distinct example was the need for special tubes at final pack due to customer requirements. The planning of the special tubes were

left to production and without the visibility of what is being loaded, often materials were not shipped due to lack of tubes. No matter how logical it was for the planning team putting the materials in place when the production plan was decided, the management team refused to change and continued to hold the production responsible for something they have no visibility. After a year working with the National Semiconductor team, F T Liu left to join DuPont Electronics as a salesman in January 1991.

CHAPTER 21

Retrenchments

"This was a regular affair in the semiconductor industry."

The semiconductor industry was susceptible to the changes in the economic landscape. In 1974, 1,160 employees, including operators, supervisors, clerks and storehands were given notice. Female production operators who turned up for duty were told to go home. Retrenchments are typically preceded by reducing the three-shift production schedule to two-shifts. This is often due to a slump in the world electronics market.

Each received a notice of retrenchment signed by the personnel manager, Mr John Lye. The notice read: "We regret to inform you that due to adverse market conditions, we have to terminate your employment with Fairchild effective Saturday. Please return on Tuesday between 8 am and 5 pm to collect your severance benefits and return your uniforms, tweezer and locker key. However, there will be selected 'C' shift personnel, who will be transferred to A and B rotation shifts. If you are selected for the transfer, we will try to inform you by mail before Tuesday specifying shift and department you are to report for work. If unable to contact you, please meet in the canteen on the specified date and time."

All operative in the plastics department on the night shift began a two-week lay-off on Monday.

With the merger of the National Semiconductor plant in Lower Delta with the Fairchild plant in Toa Payoh, a total of 90 employees were retrenched in April 1988 from a combined total of 3,800 employees. In this case, there was more joy than gloom as each of them collected at least $10,000 in retrenchment benefits. A year later, the Plastic Logic Division was moved to Penang as part of an on-going consolidation process as part of the consolidation of manufacturing operations. The target was to bring the 3,800 combined workforce down to 2,700.

With the move to Penang, National Semiconductor Singapore focused on ceramic products and higher technology packages for communications and military-based customers.

Fairchild workers milling around the factory compound in Toa Payoh yesterday.

CHAPTER 22

The Expatriates

"These expats helped the Singapore plant connect with the US operations."

Expatriates bring along with them key skills and experience to support the local operations. They also provide key linkages to the operations in the headquarters as well as other locations in the US.

Some of the expatriates include Wayne Carlson, Paul Lones, Arthur Francis, Bill Watson, Harry Van Wickle, Bruce Stromstad, Don Mamayek, Don Allain, Frank Ellis, Jim Ballard, Gunther Haller, Don Brettner, Chris Reardon, Fred Stillger, Mike Morrissette, Donald Spurling, Raymond G. Wollesen, Dave Watson, John Cameron, Dean Chandler, Bill Cawkins.

Frank Ellis began his semiconductor career in 1965 with Fairchild Semiconductor where he held various positions in engineering and operations. He stayed with the company till 1987, a total of 22 years, when it was acquired by National Semiconductor.

Frank received his electronics training in the United States Air Force which he joined right after graduation from high school in Alabama. He spent three years stationed in Japan from where he assisted the maintenance of the electronic systems in the US military outposts of the

South Pacific. He left the air force in 1959 and went back to studying and eventually graduated with a Bachelor of Science in Electrical Engineering.

Frank's career with Fairchild started in 1965 at the San Rafael facility in California. In 1976, he moved to Fairchild Hong Kong as the Engineering Services Manager for two years reporting to Dick Belcher, the MD at that time. He headed the construction of Fairchild's new LCD displays manufacturing facility to support Fairchild's new watch line. The new factory was 13 stories tall and was about 20 miles north of the Fairchild Hong Kong factory on the mainland.

Frank was transferred to Singapore in 1978 as the Product Line Manager for LSI (large scale integrated circuits) at the invitation of Bruce Stromstad, the MD of Fairchild Singapore at the time. He took over from Wayne Carlson and inherited his secretary, Elizabeth. She later resigned to get married to Donald Spurling and moved to the Americas. Diana Yip was hired as replacement.

Frank remembered well the night that he and his family arrived at the Singapore airport. "Bruce was there to pick us with his wife, Yoon. There were four in my family and two in Bruce's. We also had approximately two pieces of luggage each plus carryon bags as our household belongings had to be shipped by sea and we need stuff to last us a couple of weeks. Till this very day, I do not know how we managed to get six people and the luggage into Bruce's car. I expected the wheels to collapse any moment but we made it to Hyatt Hotel okay," recalled Frank. "Betty Ho and Y H Yeo of Finance were a great help in finding a flat for my family and enrolling my kids into school."

Frank and an extremely talented group of product engineers in the LSI test area put goals in place and instituted aggressive yield and quality targets for some of Fairchild's most complex products which included ECL, Bi-Polar Memory, MOS Memory and Microprocessor devices. The engineers responsible for the product lines were M T Ng, Ed Neo, F C Chong, K L Ang, S L Loh, N C Lam and K Y Wong. "The group was amazing. They not only met the goals on a monthly basis but exceeded them," said Frank fondly. "Plus, they were a fun bunch of people to be associated with on a daily basis." The team was committed to success and got the job done.

Another example was shipment commitments. T H Kwa and William Foo from Production Control would commit to monthly shipment numbers to the folks in US. Production Supervisors would work with the product engineers to meet those numbers. At month end, Kwa and Foo would come to the test area to assist in packing the product for shipment.

Some of the product problems Frank remembered were the one-bit failures occurring in the Bi-Polar Memory Products and the high MOS test failure rates at outgoing quality.

The Bi-Polar Memory problem was resolved by K S Lau and his team along with the manufacturing support of C E Tan and his organisation. It was due to the furnace sealing temperature profile. This was a major accomplishment due to the random nature of the problem. The MOS failure rate was resolved by instituting a 24-hour burn-in after initial test to weed out devices with weak oxide layers. The MOS Division back in the US was extremely grateful that finally the failure rate that had been affecting product shipments had been eliminated. The customers were of course, very pleased.

During the early part of 1979, Fairchild Corporate decided to introduce automatic wire bonding into the off-shore manufacturing sites. Singapore was selected to be the first to install and use automatic wire bonding for ceramic and plastic devices on the LSI product line. Initially these equipment were overwhelming to the production area and the engineering and maintenance staff. C E Tan and K S Lau and their teams made the deployment of these automatic wire bonders a success and helped increased the output and productivity. Other Fairchild Divisions followed after this.

The late 70's were also a period of tight labor supply. Frank was chosen by corporate to go to England to recruit engineers to work in Singapore on two year assignments to support the tremendous increase in activities in the test and finish area. A total of six engineers were recruited in two trips and they include Jeff, Andy, and David. At the end of their two year assignment, all of them moved to the US.

When Frank left Singapore in 1981, Don Allain took over. Frank moved back to the US at the request of Bill Kirkham, MD of the Discrete Division. He headed up the engineering responsibilities required to close down the Fairchild Hong Kong facility and to start up the Cebu Facility in

the Philippines. This included purchasing, installing and qualifying new equipment and training newly hired engineers. When equipment could not be purchased, they had to be designed and fabricated.

Frank stayed on in Fairchild and through the National Semiconductor acquisition until 1999 when he retired from the company.

Besides work, the expatriates also left Singapore with fond memories of living there. "The variety of food is overwhelming. I had never had such wonderful seafood -- chilli crabs, prawns and steamed white fish," recalled Frank. The families that came along also have fond memories. "My son played on the winning team," said Frank of the Saturday afternoon American Football games at the American School. "My daughter also played a year for the 'Powder Puff League'. And my wife loved the shopping." There was, of course, the occasional crisis. "My daughter was caught in one of the 1978 floods that caused me to panic. I managed to retrieve her but it remained a frightening experience for our family," said Frank.

CHAPTER 23

Personnel Department

"It was so convenient to work in Fairchild as I stayed across the road."
Susan Teo

After only a year in Production, Susan Teo was promoted to the Personnel Department in 1972 working under Jamilah, the Personnel Officer. Susan Teo joined Fairchild Singapore in 1971 as a production operator reporting to Chow Soon Mun, the supervisor at the Ceramic Department. She was later transferred to the Plastic Department reporting to Lim Wai Mun. John Chan was the Superintendent. Within three and a half months, Susan was promoted to become a Materials Handler assisting the supervisors and the operators.

When Susan Teo was working in Personnel, K S Lim was the Personnel Manager. "I was allowed to learn typing in the office," recalled Susan. She was put in charge of Medical/Insurance Claims as well as involved in recreation activities and orientation for new hires. "May Lee was the receptionist and I was her relief," recalled Susan Teo. "I remembered making some silly grammar mistake while paging on air. It was so embarrassing even now as I think of it." Susan was also the relief to telex operators, Hamzah and Mariamah. The telex typewriter produced a tape with holes on it with the messages encoded. "I handled private and

confidential telexes," recalled Susan Teo. "I had to liaise with the department secretaries, especially Betty Ho, who was supporting Chris Reardon, the Managing Director."

When K S Lim left Fairchild in 1973, John Lye took over as the Personnel Manager.

In 1974, there was a retrenchment exercise and Susan left the company. "I was so blur at that time that I did not accept an offer to re-join Fairchild at a lower salary," recalled Susan. "It was so convenient for me to work in Fairchild as I stayed in the block of flats just across the company."

Frankie Tan joined Fairchild in 1975 as Human Resources Manager in the Consumer Products Division. Nellie was his secretary. This was formerly Exetron, a digital watch manufacturer founded by Donald Brown. It was acquired by Fairchild Camera & Instrument Corporation headed by Wilf Corigan in 1975. Fairchild entered the consumer end-product market with the introduction of a full line of LED solid-state digital watches, ranging in retail price from US$115 to $195.

Greg Reyes, Fairchild Vice President and General Manager of the Consumer Products Division, said, "This new watch line marks a definitive move by Fairchild into the consumer electronics field. The company has for some time supplied semiconductor components, modules, and displays to digital watch companies. With our recent additions to the Consumer Products Group – particularly the Exetron Division – we were able to focus major resources in bringing to the marketplace a line of watches worthy of bearing the Fairchild name."

The Singapore Exetron operations were headed by H B Chan. Fred Stillger was the MD of Fairchild Singapore.

Linder Seah was in Personnel from 1972 to 1976. She was recruited by Han Leng to take care of the recruitment of production workers. K S Lim was the head or personnel. Adrian Wong was the Personnel/Safety Officer from 1976 to 1979.

Later, Frankie took over from John Lye, the HR Manager of the semiconductor division when the latter was fired by Bruce Stromstad, the MD of Fairchild Singapore.

In 1981, Frankie left Singapore to work in California as the Director of HR for the Digital and Bipolar Division. Tan Beng Hoe was hired from HP to take over his position.

When Beng Hoe left, Philip Low took over. He had Heng Liang Eng and Tio Phaik Hoon in his team.

Ng Buck Kun, an engineer from TI, took over from Philip when he left for Printronix.

In the early days of Fairchild, the 70's, it was rumoured that the operators were chosen based on their looks and not on their abilities. For example, the operators were asked to stand facing the wall. If their nose is touching the wall, they will be rejected.

HR also had to deal with theft cases. For many years, one of the staff from tin-plating had been smuggling tin ingots out of the factory under the seat of his motorcycle. Staff was also caught stealing gold wires and became a police case.

CHAPTER 24

IT Group

"These expats inject helps the Singapore plant connect with the US operations."

Lincoln Ee was heading the shop-floor automation project. The plan was to have central control of all test programs by integrating all the MCT Testers so that the latest revision can be loaded on to the testers. The previous method was to have individual magnetic tapes which require a lot of resources to maintain.

Later, the same concept was introduced to the assembly floor where the correct wire bonding diagram is down loaded from central servers. This eliminated costly mistakes when the wrong bond diagram is issued to the line. There were also significant improvements in productivity with the elimination of the whole paper library of bond diagrams that had to be maintained by a document control team.

"One of my most memorable experience in Fairchild was the six months I spent at South Portland to be trained on the shop-floor automation system. The plan was to implement such a system in Singapore," said C C Chia. "I was in South Portland from November so it was winter throughout my stay there." Unfortunately for C C Chia, soon after his return to Singapore, Fairchild was sold to National Semiconductor and the

shop-floor automation project was abandoned. He stayed on for another six months before leaving for Conner Peripherals in 1988.

Lincoln Ee had left for Conner Peripherals in 1987. His position was taken over by Dr Justin Lim. Many were surprised to read of Lincoln's death several years on. He was one of those who cycled to work. He died in his sleep from heart failure.

CHAPTER 25

MIS Group

"We often mat at the canteen during morning and afternoon tea break time for sharing and bonding."

Lawrence Chong joined Fairchild Singapore MIS department in 1976. He was working with Jimmy Koh, Lim Su Tjing, Tony Lee, Rama, Simon, Samsuddin, Nordin, Amy, Goh Lan Teen, Linda Pang, Linda Chew, Jessie Goh, Lucy, Ann Goh, and Doreen.

The systems deployed in Fairchild in 1976 was the …. The programming language used was COBOL (?). In those days, to get a management report out, a request is made to MIS and a programmer is assigned to the task.

The MIS team was a close knit group. "We often met at the canteen during morning and afternoon tea break time. It was a place for sharing and bonding," recalled Lawrence. "That was where we also got to know our other factory colleagues."

Outside of work, horse punting was very popular in those days at Fairchild. "Unfortunately, that was where a big chunk of our salary went," recalled Lawrence with a tint of regret. "Fortunately, when I left Fairchild, I

left the horse stories behind as well. Now my money is invested in stocks," added Lawrence.

Rose Lee joined Fairchild Singapore in 1972 in production. The following year, she was transferred to personnel working for Ms Chun Hua Meng. In 1975, she became a telex operator and in 1978 joined the MIS Group.

CHAPTER 26

IE/Facilities Department

"The frequent changes in the business necessitates a need for industrial engineering and facilities."

The industrial engineering and facilities department was responsible for the re-layout of the operations to make way for business expansion as well as relocation.

Jasmine Chua joined Fairchild Singapore on 16 June 1985 as an IE Technician reporting to W C Siew right after finishing polytechnic. "Siew as very patient with me and was one of my best bosses in my career," said Jasmine. She was trained by Siew on all that is to know about work study. Jasmine benefitted from the skills and knowledge she gained which helped her career beyond Fairchild.

Jasmine was uncomfortable with the fact that the electronics industry was not doing well then. She was affected by wage freeze during the two years in Fairchild Singapore. Work was reduced to 4-days week before retrenchment was carried out. This resulted in the low morale in the factory. As Jasmine did not want to be retrenched, she began to look for greener pastures elsewhere. "It was better to leave on own then to be retrenched. This would allow the beautiful memories of my first job to live on forever,"

said Jasmine, whose husband was Desmond Tan from A&D processing engineering.

Jasmine found guidance and friendship within the department thanks to colleagues like W C Siew, Lim Ai Hwa, Elina, L H Chua, H C Khoo and K S Loh.

CHAPTER 27

Materials Department

"They were responsible for direct and indirect materials purchasing."

J S Ng joined Fairchild Singapore in April 1979. He was recruited by then Logistics Manager, Gunther Haller as the Materials Control Supervisor with responsibility for both the materials planning and inventory control of direct and indirect materials as well as the production scheduling of the multi-pass operations and tin/silver plating line. The materials planning function covered both the Singapore and Indonesia plants.

The group under J S Ng included Yvonne, Daisy Tan and Pauline. Gunther Haller was reporting to Jim Ballard, the Production and Inventory Control Manager. T H Lim was the manager running the multi-pass operations and tin/silver plating line.

In June 1980, J S Ng was promoted to become the Materials Control/General Store Superintendent reporting to L M Wan, who was the Purchasing Manager. As a result of the General Store administration responsibility, he worked closely with Herman Leow, the Store Supervisor.

One of the major projects during this period was the transfer of the S2 (Exetron) stores from Boon Keng to Toa Payoh when the S2 plant was closed.

In January of 1982, K Y Lim took over as Logistics Manager. J S Ng became the Materials Planning Manager reporting to K Y Lim together with L M Wan, the Purchasing Manager and H C Chiang, the Traffic Superintendent. This was about the time when the Fairchild Mountain View corporate planning function was decentralised. J S Ng was sent over to Mountain View for a month in July 1982 to transfer the planning and buying responsibility of all Singapore and Jakarta materials requirements to the Singapore materials planning and purchasing team.

In January 1983, J S Ng took on additional purchasing responsibilities when L M Wan left the company. He also inherited the team of efficient and knowledgeable buyers and purchasing assistants, consisting of Patrick Ng, Steven Chan, Cindy Chia, Vincent, Karen Koh, Lynn Lee, Leslie, and Catherine. Subsequently, two more buyers, K S Koh and Nelson Koh, were transferred to the purchasing team from production. About this time, Murphy Teo took over from K Y Lim as the Logistics Manager.

A project evaluation was conducted about this period to explore sub-contracting the purchasing function to an external agency, T R Associates. This came about because of the procurement strategy of the parent company, Schlumberger which has no staffing overheads since all their purchases were handled through an external agent. The agent levied a percentage charge for every dollar purchased. It was a relief for the purchasing team when the proposal was abandoned.

In January 1984, more re-organisation followed with the transfer of the materials planning function to the production control group. This left J S Ng to concentrate solely on the purchasing function. "I visited the Laser Marking Machine vendor in Shibuya, Japan with Murphy Teo to negotiate for cost savings," recalled J S Ng. "There was also the automation of the purchase requisition in order to minimise paperwork. Purchase requisitions were submitted directly in the system for online approval by managers."

In October 1985, there was further consolidation and J S Ng became once again the Purchasing and Stores/Traffic Manager with the addition of Joe Lim's shipping stores and the traffic functions. When J S Ng left Fairchild in September 1986, Patrick Ng took over as the Purchasing Manager. "I was very glad to have exposure to all the logistic functions including materials planning, inventory control, production scheduling,

store management, purchasing, shipping and traffic," said J S Ng as he recalled the seven years spent in Fairchild Singapore.

K B Yeo joined Fairchild Singapore on 1 February 1974 just after finishing National Service. It was his first job and he stayed for 15 years. He was assigned as the Supervisor of a Plastic IC Assembly Line reporting to H W Hong, the Superintendent and the Department Manager was John Chan. K B Yeo was in charge of about 40 eager young girls working 8 hours shift in the wire bonding operations. Each shift was under the charge of a Superintendent. Besides H W Hong, the other Superintendents were S M Chou and Yeo Joo Wah. Other Supervisors were Cam Ho. "Life in those days was simple. We would walk across Lorong 3 Toa Payoh for lunch and dinners. When in the "graveyard shift" we would drive to Owen road for supper," recalled K B Yeo. He was later transferred to the Test Operations and was promoted to Superintendent and then to Manufacturing Manager. K B Yeo reported to a few bosses, Philip Low, K Y Chan and Murphy Teo.

While Harry van Wickle was the MD in 1981, a number of operators from the Jakarta plant came to Singapore for training. Charles Clark was then the MD for the Jakarta plant. "We received a personal letter of commendation from Harry for the training provided to the Jakarta operators," recalled K B Yeo.

In 1986, soon after National Semiconductor bought Fairchild, K B Yeo was transferred to the Traffic and Distribution Department, which today is called Logistics. He left in 1987 to join Printronix.

Joe Lim joined Fairchild Singapore in 1976 in production. In 1977, there was an opportunity to start a regional wareshouse so he moved over with Lim Meng Swan. "Negotiating rates with the airlines was part of the fun," recalled Joe Lim.

L M Wan joined Fairchild Singapore in 1979 as Purchasing Section Manager after leaving Exxon Singapore where he had worked for 6 years. The electronics industry then was beginning to flourish in Singapore. L M reported to Gunther Haller who was the overall Logistics Manager reporting to Jim Ballard, Production & Inventory Control Manager. At the time of joining Bruce Stromstad was the MD of Fairchild Singapore. Shortly, Don Brettner took over as the MD. When Jim Ballard went back to the U.S., Dean Chandler assumed the post of overall Materials and

Production Control Manager. L M then reported to Dean Chandler. L M worked alongside Joe Lim of Store, J S Ng (inventory/materials planning), H C Chiang (Traffic).

Apart from work, L M was active in squash in Fairchild, and he led a team of enthusiastic players in competitions against other electronics companies such as Hewlett Packard, National Semiconductor, and many others. L M left the company in 1982, after a 3-year stint to join the budding computer peripherals industry which was just beginning to take root and grew rapidly in Singapore. At one point, Singapore produced about 60% of the world's output of hard disk drives before that industry too began to fade from the Singapore scene. After Fairchild, L M worked with other hard disk drive companies such as Tandon, Micropolis, a contract manufacturer, Tri-M Technologies, and Quantum. His last job was with Quantum as General Manager before retiring in 1997 and migrating to Perth in 1998. “Fairchild was a good training ground that gave many of us opportunities to spread our winds in the electronics industry during the golden years in Singapore,” said L M Wan

CHAPTER 28

Automation Group

"Fairchild Singapore had an automation group that was responsible to develop the test handlers."

The automation group was an independent group responsible to develop the test handlers used in the production floor. Some of the folks there were T Y Lim, Stanley Tan and Robert Goh. The whole team left Fairchild in 1984 and formed IC Equipment Pte Ltd.

S P Wan joined Fairchild Singapore as an equipment engineer in 1982. She was involved in the design and development of in-house automated equipment for production. This involved commissioning the equipment when deployed in the production line and meeting all the required performance specifications. S P Wan left Fairchild with the rest of the automation team and became a senior product manager in IC Equipment Pte Ltd where she stayed for 21 years.

CHAPTER 29

Finance Department

"The Finance Controllers were mainly expats."

Department secretary Helen Phang worked for 7 Finance Controllers over a span of 28 years in Fairchild Singapore. Boon Kim Guan and Chuck Simon interviewed her in November 1975. "I always felt indebted to Mr Boon for offering me the job," said Helen."I realised that I was the only one called up for a second interview when the Security Guard asked me if it was my first day at work." But she did not work for him because he left for the States for training when she started work in Fairchild Singapore.

The Finance Controllers Helen worked for during the 28 years in Fairchild Singapore were Frank Strubel, Maxwell Maydew, Y H Yeo, Bob Baksh, Richard Thompson, Tom Gurney and Jimmy Tan (From National Semiconductor).

CHAPTER 30

Life After Fairchild

"Our time in Fairchild Singapore has given us the foundation to venture into other fields."

We are grateful for the training and exposure gained during our time in Fairchild Singapore. It has given us the foundation to venture into other fields. While each has chosen their own paths forward, three organisations have stood up where a significant number of Fairchildren have joined: Conner Peripherals, IBM Storage Division and StatsChippac.

Lincoln Ee left Fairchild Singapore to join new start-up, Conner Peripherals led by H B Chan. "Lincoln asked me to help him set up the IT Department and its infrastructure at Conners," recalled C C Chia. "I stayed there for almost 8 years until the company was acquired by Seagate."

Below is a March 1989 announcement in The Straits Times by Conner Peripherals acknowledging the contribution of the team to the company's success. "My name is top of the list as it is in alphabetical order," said C C Chia. "You can recognise many other ex-Fairchild Singapore folks in the list."

THANKS TO ALL OF YOU, WE HAVE THE DRIVE TO SUCCEED.

The Conner Peripherals Singapore Manufacturing Team has been the key to our record-setting three-year growth. You have helped us become the world's leading supplier of high-performance 3½-inch hard disk drives.

We couldn't have done it without you.

Chia Chian Chai
Karen Chia
Nancy Chiok
T. H. Chua
Lincoln Ee
Lee Liang Huang
Chua Kuan Hwee
William Kan
Lee Wah Kee
Patrick Ngo Swee Kiat
Esther Koh
W. H. Koh
Cheng Peng Koon
Peter Kwang
Dax Kwok
Anne Lai
K. S. Lau
Johnson Lee
Ronald Leng
S. C. Leong
Lawrence Lim
Pauline Lim
Ho Shwu Ling
Serene Loh
William Low
R. Mahendran
F. L. Mak
Francis Maniam
H. B. Ng
Michael Ng
E. H. Poh
Goh Kim Siew
H. K. Sim
Ng Kim Soon
C. M. Tan
Joseph Tan
Laura Tan
P. H. Tan
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David Ong Eng Teck
Ann Teo
H. K. Teo
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A number of former Fairchild Singapore employees have migrated to Perth, Australia. Louis Pang is a successful businessman in Perth operating a computer business. His wife, Peggy, used to be the secretary in the Purchasing Department in Fairchild Singapore. Victor Foo, the former Finance Manager is also in Perth since the 80's and later joined by K S Ng. Some like L M Wan has picked up other interests like being a Bible Teacher as he has picked up a Masters of Arts degree in Theology. He has published a book "Israel – A Light Unto the Nations" which is also sold in Singapore.

A number of Fairchild employees started a burn-in services company, called KES. The company name came from the three founders – K C Lau, Ed Boothman, and Sam Lim.

Appendix 1

Letter to The Straits Times – 6 February 2012

"Semiconductor industry flourished under his watch."

NOT much has been reported about Dr Toh Chin Chye's stint as the Minister for Science and Technology from 1968 to 1975. Those were the critical years when Singapore decided to open its economy to attract high-tech multinational companies to take advantage of the lower costs of manufacturing here.

During that period, world-class multinational companies like Fairchild Semiconductor and National Semiconductor set up factories in Singapore and brought with them technological know-how and provided jobs for Singaporeans.

Dr Toh, as Minister for Science and Technology, officially opened the Fairchild Singapore factory in Lorong 3, Toa Payoh on Dec 4, 1969. It was also the first factory in Toa Payoh.

In his speech, he said: 'The establishment of this factory is for Fairchild a small step, but like proverbial drops of water which go to form a mighty ocean, we believe that many such small steps can go to make a mighty leap for Singapore into the industrial age.'

Former employees of the Fairchild Singapore factory met last Saturday for their annual Chinese New Year *'lo hei'*. It was a coincidence that we heard news of Dr Toh's death.

The birth of the semiconductor industry in Singapore happened under his watch as Minister for Science and Technology. The annual output of the semiconductor industry increased from nothing in 1968 to $130 million in 1970, $290 million in 1972, and $470 million in 1974.

After nearly 20 years, the Fairchild Singapore factory ceased to exist in 1988 when it was acquired by National Semiconductor. After almost another 20 years, in 2006, the factory was shut down by National Semiconductor and the operations moved to Malacca and China, marking the end of an era in Singapore's semiconductor industry.

Liu Fook Thim

Appendix 2

Guide questions to aid in Fairchild Memories

"Memories fade. We do understand. So the following questions are to provide some guideposts."

When did you join Fairchild?

Who did you report to?

What was the nature of your work?

Who was the MD at that time?

What department(s) did you work in?

Who are the colleagues you remembered?

Any significant events/people you remembered?