IT Hardware & Electronics: Appendix B- Case Studies of innovative projects

1. Taiwan Semiconductor Manufacturing Company Ltd. – Taiwan

Taiwan Semiconductor Manufacturing Company Ltd. (TSMC) was formed in 1987 as a joint venture between the Taiwan government, which wanted to promote the development of the island's semiconductor industry, and Philips Electronics NV of The Netherlands. The company was set up by Morris Chang, who had been invited by the Taiwan government in 1985 to come to the island and help grow its semiconductor industry. Chang was born in China and educated at the Massachusetts Institute of Technology (MIT) and Stanford, where he earned a doctorate in electrical engineering. He was the president of General Instrument Corp. when he left to go to Taiwan.

When TSMC was founded in 1987, it was a major catalyst in transforming Taiwan's semiconductor industry. It provided state-of-the-art manufacturing processes that complemented Taiwan's strength in chip design. Between 1987 and 1992 TSMC gradually added to its foundry capacity by vertically integrating into related disciplines, including wafer sort testing in 1988, mask-making in 1990, and design services utilizing technology licensed from VLSI Technology in 1991. It also improved its process technology. After starting as a six-inch, 2-micron wafer-processing fabrication facility, or fab, it broke the 1-micron barrier in 1991.

TSMC originally was intended to service Taiwan's design houses, which were noted for their chip designs but did not want to get involved in manufacturing processes. TSMC, however, soon became an internationally oriented, profit-driven organization that supported the development of fabless semiconductor companies, that is, that did not own their own manufacturing facilities. Fabless semiconductor companies were strong on design, but they could not afford the large investment required to build their own fabrication facilities. By 1992 TSMC was rated as the world's top silicon foundry, producing chips for other companies. TSMC employed 250 process engineers and was on the cutting edge of process technology. TSMC accounted for 80 percent of Taiwan's production of SRAM and also produced a variety of other semiconductor chips, including DRAM and EPROM. Revenue for 1992 was around $245 million.

Building New Facilities to Expand Capacity: 1994-96

By 1994 demand for chips was exploding with new applications in multimedia and portable computing. At the beginning of the year TSMC announced plans to build a new eight-inch wafer fabrication facility, or fab, that would double the company's output to more than $1 billion worth of product a year. The new plant was the company's third fabrication facility and cost about $800 million to build. At the time TSMC was running several different processes for both logic and memory chips, and the company was running out of capacity.

In September 1994 TSMC went public on the Taiwan Stock Exchange. Before the end of the year TSMC announced an agreement with Advanced Micro Devices Inc. (AMD) to provide foundry services for AMD's AM486 processors. For 1994 TSMC reported sales of $744 million and net income of $325 million. A 60 percent increase of worldwide semiconductor sales between 1992 and 1994 resulted in a global shortage of wafer fabrication capacity. About 60 percent of TSMC's sales were to fabless semiconductor companies, with the remaining 40 percent going to companies short of manufacturing capacity. TSMC's gross margin of 49 percent was the highest in the semiconductor industry.

In March 1995 TSMC announced that it would build another eight-inch wafer fab at a cost of $1.2 billion. The new plant, TSMC's fourth fab, was designed to operate at 0.4-micron initially and later at 0.25-micron, which was about one generation ahead of the eight-inch 0.5- to 0.35-micron plants proposed by other Taiwan semiconductor manufacturers. Construction on the new eight-inch fab began in November 1995. Some of the funding for the plant came from deposits that customers made to ensure long-term fab capacity, an option that TSMC began offering to customers in mid-1995.

Between 1993 and 1995 TSMC nearly doubled its capacity to produce six-inch (150mm) wafers, from 665,000 wafers in 1993 to 1.2 million in 1995. Its six-inch fabs, including Fab 1, Fab 2A, and Fab 2B, were running at full capacity, producing 100,000 wafers per month. Fab 3, which produced eight-inch wafers, was expected to ramp to full capacity of 22,000 wafers per month in 1997 and 35,000 per month in 1998. Fab 4 was expected to come online in 1997 and ramp to full capacity of 25,000 eight-inch wafers per month in 1998. The construction of Fab 5 in Hsinchu was announced before the end of 1995.

In November 1995 TSMC and Altera Corp. announced a joint venture to build a wafer fabrication plant in the United States. After considering sites in Oregon and British Columbia, TSMC selected Camas, Washington, for the $1.2 billion plant. The plant would have the capacity of producing 30,000 eight-inch wafers per month, starting with line geometries of 0.35-micron and then migrating to 0.25-micron. By mid-1996 TSMC had signed on two more joint venture partners for the plant, to be called WaferTech; they were Analog Devices and Integrated Silicon Solutions Inc. (ISSI). Altera's $140 million investment gave it 18 percent ownership of WaferTech. Analog Devices also owned 18 percent, ISSI owned 4 percent, private investors owned 3 percent, and TSMC owned 57 percent.

At the end of April 1996 TSMC became the first Taiwanese company to be listed on the New York Stock Exchange when it raised more than $500 million through the sale of 305 million ADR (American depository receipt) shares. At the time Philips Electronics owned about 35 percent of TSMC. For 1996 TSMC reported sales of $1.45 billion and net income of $718.5 million.

2. PPP partnership for trade & investment : UNCTAD & Royal Philips Electronics Corporation

Public-private partnerships in trade and investment can promote international trade with a focus on promoting development as well as meeting global and national development priorities. In order to strengthen the participation of developing countries in new and dynamic sectors, public private partnerships will be needed. A trend-setting example in this regard is the UNCTAD-Philips initiative on the electronic/electrical sector in southern Africa. As the Philips initiative shows, moves to set up trade-related industries and FDI in sub-Saharan Africa could set an example of the corporate world undertaking responsibility for development and of creating stakes for developing countries in trade-driven liberalization and globalization. UNCTAD and Royal Philips Electronics Corporation are engaged in a project with a view to establishing energy saving light-bulb industry in the Southern African (SADC) region. The project seeks to strengthen cooperation among SADC Members by creating competitive supply capacities in energy saving light-bulb products; promoting trade among SADC countries; promoting energy saving in the SADC region to meet the challenge of rising energy costs; and improving environmental sustainability by reducing green gas emissions. The project is an example of UNCTAD's innovative approaches to promoting public-private cooperation and partnerships geared towards the development of new and competitive productive capacities in African countries, which strengthens their participation in new and dynamic sector of international trade. This in turn contributes to their industrialization whilst also serving the purpose of promoting energy security.

3. China's e-waste regulation

CHINA - The State Council has approved a draft regulation on the management of electronic waste or WEEE (Waste Electrical and Electronic Equipment), which will tightly control the end-of life use of main consumer electrical products such as televisions and computers. As with most of China's new wave of environmental legislation, the regulation was initially issued in draft form '"for public comment" before being passed into law. Draft Proposal on Recycling and Treatment of Waste Electrical requires mandatory recycling of, electrical and electronic appliances discarded by the consumer, elements, parts, spares and components and consumable materials discarded in the process of manufacturing [and/or] maintaining electrical and electronic appliance.

As with all Chinese legislation of this nature, the WEEE regulations come with the main body of the law and supplementary appendix, known as the 'Catalogue.' Essentially if a product is listed in the Catalogue or referred to in the main body, then all the product parts, components, spares and consumables will be covered by this law.

The 2008 draft Catalogue requires mandatory recycling of; Televisions of all types (CRT, LCD etc.), refrigerators, washing machines, air-conditioners, and computers – this however is listed as 'batch one' an indicator that the Catalogue is to be expanded greatly.

- Recycling shall be conducted only by operators licensed by the relevant local authority department charged with 'resource comprehensive use' – allowing for the fact that different regions or cities may have allocated different responsibilities to various departments.

- A special fund for Waste Electrical and Electronic Appliance Treatment is to be set up by these departments responsible for 'resource comprehensive use', which will come under the scrutiny of the State Council.

- Manufacturers must adopt product designs that use non-hazardous treatment of resources, select non- or minimally hazardous and toxic materials or materials that are easily recycled and reused, and meet recoverability ratio to be set. Manufacturers should also use designs that favour 'circular use'.

- They should also provide information on the product composition, recycling and treatment instructions associated with the product and materials – this overlaps with provisions in China's RoHS regulation.

- Article 10 requires manufacturers to deliver waste electrical and electronic appliances generated in the manufacturing process to qualified treatment enterprises, while waste electrical and electronic appliances must be recycled through sale and post-sale service outlets, and deliver the waste electrical and electronic appliances to licensed treatment enterprises.

Further, legal liabilities and penalties were also introduced:

- Dealers and post-sale service operators that do not take manufacturers' product to qualified treatment operators shall be punished with a fine up to US$7,300 (¥50,000).

- Used or second-hand dealers with products which have not been tested and labelled by qualified treatment operators may have used household appliances, earnings and profits confiscated and face fines of up to US$7,300 per item.

- For unauthorized dismantling, assembly and parts sales fines ranging from $700 to $6,000 will be imposed.

- The 'chief officer' of government departments and other public servants failing to recycle e-waste shall face disciplinary action.

- Where serious losses are incurred by consumers due to the sale of waste. Or second-hand, electrical and electronic appliances, the operators may have their business licenses revoked or suspended, be subject to criminal proceedings.

- In an anti-corruption measure, the Law states, "Governmental functionaries who abuse power, trifle with duty, or practice favouritism and engage in irregularities in manners that constitute crimes, shall be subject to criminal responsibilities."

4. <u>Office of Chief Scientist Model - Israel</u>

The Chief Scientist Office in the Ministry of Industry, Trade and Labor, Israel is mandated to execute the Government's industrial R&D support policy, by force of the Encouragement of Industrial Research & Development Law. Various modules of the model are:

- *Industrial R&D support:*

  - R&D program for developing an innovative product; the level of support is 20-50% of the approved budget.

  - R&D program in special areas: An R&D program that takes place in an area that is defined as "Development Area A" – according to the Law for the Encouragement of Capital Investments" – is eligible for an additional grant of 10% on top of the grant that was approved by the Research Committee. An R&D program which is performed in an area that is defined as a "confrontation zone" is eligible for an additional grant of 25% on top of the grant that was approved by the research committee. The submission dates vary according to the size of the requested budget. The dates are published on the website of the Chief Scientist Office. A company must submit all of its applications (regardless of the date of the commencement of the project) at a single date during the year. A complete application includes the application form, the company questionnaire and the budget file. The application should be sent via the internet. The files should be downloaded, filled-out and then be sent via the internet, as specified in the directives. Two signed copies of the declaration forms that are found at the end of the company questionnaire should be sent by mail to the Office of the Chief Scientist.

- *Support for a technology entrepreneur taking his first steps:*
  - "Tnufa" (Momentum): Support for inventors, entrepreneurs and start-up companies, taking their first steps towards the implementation of their idea. The partial grant provided by the fund involves the following area: Patent preparation, the construction of a preliminary prototype for the purpose of demonstration and/or proof of feasibility, preparation of a business plan and efforts to raise initial capital. The grant rate in this support track is 85% of the program's approved budget, up to a cap of $50,000.
  - "Technology incubators": The incubator serves as a supportive framework for the entrepreneur that enables him to turn a technological idea that has an economical-marketing potential into a product of interest for investors, as an independent company. The Government's R&D grant rate for companies is 85% of the approved budget while the rest is

provided by an outside investor. There are currently 24 incubators throughout Israel. Some of the recent innovations in this area are: An experimental program for privatizing some of the incubators; Establishment of dedicated Biotechnology incubators, as a part of the emerging policy in this area.

- *Royalties:*
  Any income accruing from the successful commercialization of an R&D program, receiving financial support from the OCS is subject to royalty payments to the OCS. Royalty payments are generally calculated as a percentage of sales income and are paid via "Keren Temura" of the Chief Scientist Office. The precise detail of royalty rates as well as the reporting procedures are specified in the Encouragement of Industrial Research & Development Regulations (Rate of Royalties and Rules for its payment), 1996.

- *Industry-Academia cooperation for the development of technology infrastructures in the Industry*
  - "Magnet" program: This program is designed for the execution of pre-competitive R&D within the framework of a consortium that includes a number of industrial companies along with researchers from at least one academic institute. The research focuses on the development of pre-competitive (generic) innovative technologies that will be the base for new state of the art products and processes. The grant rate for the industrial company is up to 66%, and for the research institute – 80%. If a foreign company has a unique contribution for a specific consortium, it may be included in the project.
  - "Magneton": This program is designed to encourage know-how transfer from the university community to the Industry that may lead to the development of a defined product. The grant rate in this support track is 66%.
  - "Nofar" program: This program is designed to support the advanced stages of applied research which is carried out in a university laboratory, independently of any specific product, and that has raised interest within the business community. The program is for one year, with a budget of up to 420,000 NIS. This represents a grant of up to 90%, with the industry funding the difference.
  - Association of users for the distribution and adaptation of generic technologies: The program is designed to facilitate the distribution and implementation of generic technologies that were developed in Israel or elsewhere and are deemed essential for the members of the association.

- *International collaboration in industrial R&D*
  Technological collaborations with foreign companies have proven to be mutually beneficial to all of the involved parties. In addition to the joint R&D development deeper business ties often evolve. These collaborations are manifested in one of three models:
  - Bi-national funds for industrial R&D .The fund is created by means of an agreement between Israel and a foreign country where each country allocates a given sum toward the fund's operation for a pre-determined period of time. The fund encourages industrial R&D collaboration between paired companies (one from each country) and also assists in matching potential partners from each member country. The grant rate is usually 50% and it is subject to the payment of royalties to the fund. For details see the information website of the appropriate fund.
  - Participation in the European Union's framework programs: The European Framework program is a liberally endowed enterprise of the European Union that involves industrial R&D collaborations in selected fields. The program's main benefit lies in the joint work that takes

place with Europe's leading research bodies. Israel partakes in these programs through ISERD, the Israeli Directorate for the program.

- EUREKA Program Eureka is a network uniting 31 European countries for the purpose of encouraging R&D collaborations between industries and research institutes. An Israeli company may apply for a grant to the Office of the Chief Scientist based on its approved status as a Eureka participant. A grant for an Israeli company shall be given in accordance with the Encouragement of Industrial Research & Development Law, 1984.
- Parallel-support agreements: These agreements were signed with several countries and they facilitate R&D collaboration between an Israeli company and a foreign company. Companies are given support by the bodies that are responsible for the promotion and support of industrial R&D in their respective countries. The Israeli company is entitled to receive support from the Office of the Chief Scientist. Responsibility for the implementation of these agreements is handled by the Israeli Industry Center for Research and Development (MATIMOP) which engages, among other things, in locating foreign partners for Israeli R&D companies