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**TECHNOLOGY**

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## Joint Ventures Help Leverage DRAM Price Crash

Despite the current market decline, Texas Instruments has planned well in establishing a balanced mix of sharing investment risks and taking advantage of market opportunities.

While many semiconductor companies are feeling the crunch of the chip market sizing down the prices of dynamic random access memory chips (DRAMs), TI is well positioned and continues to grow despite market downturn. Layoffs and stalled construction plans have already begun to occur in many companies. From the equipment manufacturer to the chip maker, the trend will affect companies such as Fujitsu and Oki Electric Industry, Hitachi, NEC and Mitsubishi Electric.

Despite the current decrease in DRAM prices, the worldwide semiconductor market is expected to continue to grow at an average rate of 20 percent or more for the remainder of the decade. The projection is based primarily on the basic need for semiconductors in electronic equipment and the emergence of new markets in Asia. In fact, between 1994 and 1996 the average memory per PC is expected to double, and that number is expected to double again by 1998. This is being driven by the availability of powerful new microprocessors and by the increased complexity of software operating systems and applications.

Anticipating this trend, TI formulated a business strategy that involves a shared investment plan to reduce the risk of volatility in the memory market. This type of joint venture capital investment strategy has allowed TI to effectively gain market share, reduce expenditures and stabilize profits during

down times, not to mention gain a large competitive advantage.

DRAMs now account for about 35 percent of TI's total semiconductor revenues, and by sharing the expense of operating a wafer fab, the company has saved nearly \$2 billion in capital expenditures. By 1997, TI expects to have saved more than \$5 billion through shared investments.

Since 1989, TI has established five joint venture companies, four of which are located in Japan and Asia, and one is located in the United States.

Alphatec Electronics and Texas Instruments Semiconductor Company Limited (Alpha-TI), is the most recent TI joint venture company. Alpha-TI is the fifth joint venture for TI and is currently under construction. The company is located in AlphaTechnopolis, or the Silicon Valley of Asia, and will be part of a development site that houses some of Thailand's leading technology companies, including Alphatec Electronics, SubMicron Technology, Microchip Technology and NECTEC. Alpha-TI is expected to begin production of 8-inch 0.35-micron wafers by the first quarter of 1998.

TI and Hitachi Ltd. joined forces and developed the semiconductor industry's first joint venture manufacturing facility in the United States, named TwinStar Semiconductor, in December 1994. Based in Richardson, Texas, TwinStar is a cooperation that was

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as recognition by governments of the importance of electronics as one of the world's fastest-growing industries. The company uses sub-micron complimentary metal oxide semiconductor (CMOS) manufacturing technology to produce DRAMs and also produces advanced logic semiconductors in response to market needs.

KTI Semiconductor Ltd., a joint venture between Kobe Steel, Ltd. and TI in Nishiawaki, Hyogo Prefecture (western Japan), was formed in 1990 and began production in 1992. The devices that are manufactured at KTI are 16-megabit DRAMs, as well as applications-specific integrated circuits (ASICs), and are sold exclusively to TI for distribution. The facility is capable of manufacturing integrated circuits in which the smallest structures fabricated on the wafer are only 0.5 micron in feature size.

Acer formed a joint venture with TI back in 1989 to ensure its source of DRAMs for its personal computers, peripherals and communications products. TI-ACER was the first memory chip production plant in the Asia-Pacific region outside of Japan. Output from the \$250 million facility is sold exclusively to TI, which in turn guarantees up to 50 percent of the total to ACER.

In addition to these joint ventures, TI will be adding capacity to TI-owned facilities in Averzzano, Italy and to the DMOS-5 (Dallas Metal Oxide Semiconductor) fab in Dallas. Based on long-term growth, TI estimates that the industry will need at least 40 new DRAM manufacturing facilities equivalent to this one over the next five to six years, far more than currently are announced or under construction.

There are several elements involved in TI's global memory strategy. TI has implemented what is considered a "harmonization" process with respect to equipment specifications and process standardization. TI essentially duplicates technology from its main facility in Dallas and applies it to each joint venture. TI's Manufacturing Science and Technology Center (MSTC) serves as the main hub where there are "master control programs" deployed in all TI joint ventures.

As the DRAM market changes with new architectures and higher-performance devices being developed, the balance of supply and demand may vary somewhat with tighter supply of the new architectures and more pricing pressure on the older products.

Memory is no longer a one-size-fits-all product. To get the full ben-

efits of higher-speed processors, the market is transitioning to new families of faster DRAMs. For example, the "page mode" memories have moved towards "extended data out," or EDO, memories and will soon move to synchronous DRAMs, which will increase performance by up to four times that of today's memory products. Synchronous DRAMs, which operate at the

microprocessor's clock speed, are now being designed into next-generation PCs and by the 1997-1998 timeframe will be the industry standard. ★

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