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ROCSAT-I Satellite Is Successfully Launched

Bearing the nation's blessings, the ROCSAT-I satellite was smoothly launched from America's Cape Canaveral space center at 8:34 A.M. (Taiwan time) on January 27, 1999. At 11:16 A.M. of the same day the satellite mission control center at Hsinchu in Taiwan used telemetry and tracking commands to receive the first batch of data and assume control of the ROCSAT-I. The ROCSAT-I marks the first time that the people of the R.O.C. have participated in the design and manufacture of a satellite, performed integrated testing, and autonomously taken charge of control and operation. The successfully launch and trouble-free operation of the ROCSAT-I is an important milestone in the R.O.C.'s development of space technology.

Responding to the changing international environment and the needs of national development, in 1988 President Lee Teng-hui instructed the Executive Yuan to draw up a plan for the research, development, and application of space technology. In October 1991 the Executive Yuan approved the "National Space Technology Long-term (15-year) Development Plan" proposed by the NSC, and began gradually establishing the R.O.C.'s space technology groundwork and systems engineering capability. Although the R.O.C. began its exploration of space thirty years later than many of the advanced nations, under the NSC's leadership the National Space Program Office has at last delivered concrete results in the form of the successful ROCSAT-I launch.

ROCSAT_I Satellite is successfully launched at 8:34 AM (Taiwan time) on January 27, 1999.

The planning, design, fabrication, assembly, integrated testing, launch, and operation of the ROCSAT-I has the following implications: (1) The cumulative achievements of the Space Program Office demonstrate the abilities of its newly-trained team of space technology specialists. (2) The satellite proves the R.O.C.'s ability to develop space technology and reach new levels of science and technology (3). It enables the domestic space component and satellite industry to enter international markets, consolidates the foundation of the space technology industry, and opens commercial opportunities for makers of space components. (4) It provides many overseas space science and technology researchers with new tools and information, promoting international cooperation. (5) It changes R.O.C. from a space information consumer to a space information producer, raising the nation's international standing.

Because space exploration is a capital- and technology-intensive undertaking, it represents the direction industrial development is headed in the 21st century. The success of the ROCSAT-I proves that the R.O.C. now possesses the means to develop a satellite industry. The application of the experience and knowledge gained from the ROCSAT-I to the future ROCSAT-II and ROCSAT-III will insure that these projects proceed smoothly and serve as the cornerstone of a high-tech aerospace industry benefiting the public and serving national needs.

After its trouble-free launch on January 27, the ROCSAT-I had already completed 178 orbits by February 8, and during 90 orbits it passed through the communications range of the satellite ground station in Taiwan. The mission control center located at the National Space Program Office in the Hsinchu Science-Based Industrial Park uses telemetry and tracking command stations in Tainan and Chungli on Taiwan and an overseas tracking station to monitor and control the satellite's status 24 hours a day. Tests of major hardware and software have confirmed that everything has been functioning normally after the satellite's first orbits. On February 1 the satellite was put into a "science mode" to facilitate the testing and calibration of the three scientific payload instruments following the testing and correction of the satellite bus.

The mission control team at the Space Program Office has been working two shifts a day around the clock to control the satellite. It is expected that the preliminary orbital control period will be completed by the end of March, and at that time the satellite can begin its normal science mission.

ROCSAT-II Satellite Plan is Completed

The second satellite in the National Space Technology Long-term Development Plan—the ROCSAT-II—was approved by the Executive Yuan in October 1997 as a low-orbit small remote-sensing satellite. The National Space Program Office immediately established a project task force charged with using its members' many years of systems engineering experience to perform overall planning. Design of systems including mission definition, needs analysis, satellite bus, remote sensing payload, scientific payload, ground system, and launch vehicle, etc. was completed by July 1998.

The planning results have been reviewed and assessed by domestic and foreign experts on numerous occasions, and the views of internationally-prominent satellite firms have been widely sought in an effort to confirm the design. Notable features of the ROCSAT-II plan include the following: (1) The mission will emphasize resource surveys meeting the needs of the government and private industry. (2) The sophisticated remote-sensing technology deployed on the satellite will spur the development of spinoff technology that will be highly competitive in international markets. (3) The design and development of the satellite will involve international cooperation and make full use of the Space Program Office's existing manpower, technology, and facilities; the project will strengthen the R.O.C.'s autonomous satellite technology capability. (4) Widespread participation by domestic industry will enable firms to acquire a higher level of technology, and help them make the jump from developing single components to leading the development of entire satellite subsystems; the R.O.C.'s level of satellite technology will take a great leap forward.

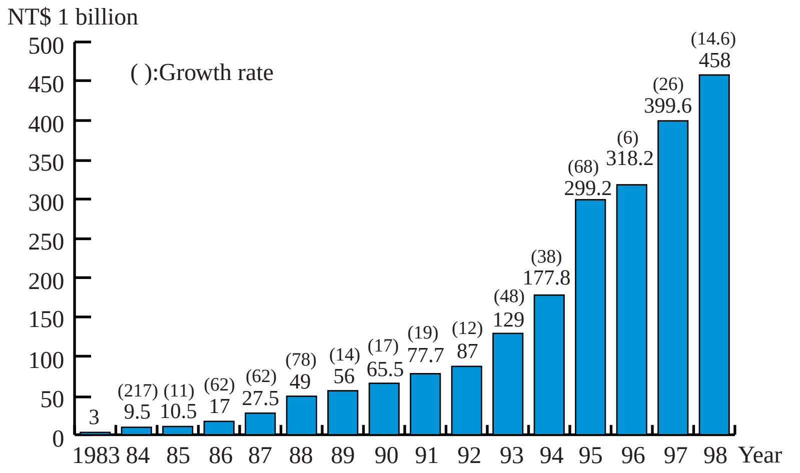
The Space Program Office is actively performing preparatory work that will lead to the development of ROCSAT-II systems, including procurement contracting tasks. The most important work encompasses the satellite portion (including satellite bus and remote sensing payload), and during January 1999 the German firm Dornier Satelliten Systeme GmbH was selected as prime contractor following open bidding and a rigorous cost-benefit assessment. The contract signing procedures were completed on February 8. A high-altitude atmospheric lightning camera has been chosen as the scientific payload, and the camera project will be conducted jointly by National Cheng Kung University, National Central University, the University of California at Berkeley, and the University of Alaska. The scientific instruments needed for this project will be developing in conjunction with a suitable partner selected by the Space program Office. The ground system will be based on the existing ROCSAT-I control center, and the Space Program Office will autonomously perform the planning, design, hardware acquisition, and software development work needed to enable the system to simultaneously control several satellites. A remote sensing image receiving station will use existing facilities at National Central University with the addition of a few relatively minor improvements.

According to the current timetable, it is expected that development and manufacture of the satellite bus and two payloads will be completed by September 2001. The Space Program Office will perform integrated testing, and the launch date has been provisionally scheduled to be between August and December 2002. The final determination of the launch date will be made after the launch vehicle and launch site have been arranged.

1998 Business Report of the Hsinchu Science-Based Industrial Park

The turnover, approved new investment, and paid-in capital of firms in the Hsinchu Science-Based Industrial Park (HSIP) all hit record highs last year (1998). Turnover of NT$458.0 billion in 1998 eclipsed the 399.6 billion turnover of 1997 by 14.6%. Of the six major industrial categories represented in the HSIP, integrated circuits earned the highest turnover of NT$230.8 billion, which was 50% of total HSIP turnover and up by 15% from last year. Computers and computer peripherals were next with NT$159.7 billion turnover, which was 35% of total HSIP turnover and up by 13% over the previous year. Communications products earned NT$30.4 billion, which was 6.6% of total HSIP turnover and up by 12% over the year before. The category of electro-optics took in NT$29.7 billion, which was 6.5% of total HSIP turnover and 7% more than the previous year. The category of precision machinery firms took in NT$6.8 billion, or 1.5% of total HSIP turnover, and enjoyed growth of 100% from the year before. Biotechnology firms had a turnover of NT$600 million, which was 0.1% of total HSIP turnover and an increase of 50% over the previous year.

Turnover Growth from 1983 to 1998 in the Hsinchu Science-based Industrial Park



Turnover Growth of Six Major Industries in the Hsinchu Science-based Industrial Park in 1998

Industry	Turnover NT$ 1 billion	Growth rate (%)
Integrated circuits	230.8	15
Computer and peripheral	159.7	13
Communications	30.4	12
Electro-optics	29.7	7
Precision Machinery	6.8	100
Biotechnology	0.6	50
Total	458	14.6

As for the many industrial subcategories at the HSIP, the areas of packaging, wafer fabrication, and circuit design in the category of integrated circuits all enjoyed growth of 30% or more. The areas of electronic parts and components, network equipment, and microcomputer equipment in the category of computers and peripherals grew by at least 30%. User terminal equipment in the category of communications products enjoyed exceptional 57% growth. Batteries, flat-panel displays, and optical element systems in the category of electro-optics all grew by 45% or more. The category of precision machinery grew by an outstanding 100% last year, and the areas of precision molds and precision elements and components more than doubled their sales. The category of biotechnology grew by 50% over the previous year, and the area of medical equipment more than doubled sales.

Plentiful business opportunities in the HSIP has stimulated a wave of new investment, and 42 newcomer firms with capital investment of NT$32.23 billion were established in 1998. The sixteen of these firms founded by Taiwanese researchers and specialists returning from overseas constituted capital investment of NT$12.12 billion. Of the other firms, 23 were founded by groups of local entrepreneurs, two were joint ventures, and one was a subsidiary of a foreign firm. In addition, 84 firms already operating in the HSIP increased their capitalization by NT$134.613 billion. The total capitalization of HSIP firms thus increased by NT$166.843 in 1998, which set a record by being the fourth consecutive year in which capital increased by more than NT$120 billion. Furthermore, paid-in capital reached NT$135.1 billion in 1998, showing that the HSIP was not affected by the Asian financial crisis and domestic economic slowdown. Cumulative paid-in capital at the HSIP has now reached NT$510.7 billion.

Among newly-established HSIP firms, the 18 firms in the category of integrated circuits included nine in IC design, two in power and radio frequency IC manufacturing, and others in such areas as mask fabrication, back-end assembly and testing, semiconductor equipment, and wafer fabrication, etc. Of the seven new computer and peripheral firms, some specialize in ultra-high speed network cards and hubs in the booming area of network equipment, and others are developing user-friendly pen input equipment, advanced output systems, and special communications software, etc. Of the seven new communications technology firms, three make Internet gateways (ITGs), one makes terminal control elements for aircraft passenger personal information systems, and the rest develop and manufacture microwave semiconductor elements and other key components used in wireless communications. The eight electro-optics firms are responding to demand for notebook computers, mobile telephones, and electro-optic storage devices by developing face emission laser diode dice and modules, membrane transistor liquid crystal displays, optical engines for single-gun liquid crystal projectors, multi-function CD-ROM devices, rewritable digital multi-function CDs, and rechargeable lithium ion batteries and battery modules. The two new biotechnology firms manufacture nucleic acids, nucleotides and their derivatives, raw medicines and microbiological preparations, biological pesticides/ fertilizers, and biochemical nutrition products, etc. On the whole, approved investment cases in 1998 displayed a trend towards diversity, and appear very promising in both qualitative and quantitative terms.

Among existing HSIP firms that increased their capitalization, of the 39 such firms in the category of integrated circuits, eight integrated circuit fabrication firms made the largest investment, followed by 17 IC design firms. Other investing firms in this category included two mask fabrication firms, three back-end integration/assembly/testing firms, and nine semiconductor equipment and wafer materials firms. Of the 15 computer and peripheral firms that increased their capitalization, the greatest share of new investment was made by three notebook computer manufacturers, four makers of ultra-high speed network cards and hubs, and two scanner manufacturers. Other investing firms in this category included three companies developing output storage systems, memory modules, and software. Of the 11 communications product firms that increased their investment, seven make cable user terminal equipment, one makes cable transmission equipment, and the remaining three chiefly develop and manufacture microwave equipment for use in wireless communications. Four of the 13 electro-optics firms that increased their capital manufacture notebook computers, LCD monitors, and liquid crystal projectors. Another five firms manufacture LED dice and wafers, two are manufacture optical film elements, one manufactures infrared cameras, and one is developing rechargeable batteries and battery modules. The three precision machinery firms that increased their capital are devoting their attention to precision instrumentation and precision elements. The two biotechnology firms that increased their capital respectively produce vaccines and medical equipment.

In 1998 the R.O.C.'s imports and exports shrank in the face of such adverse factors as the Asian economic crisis, worsening economic conditions in Southeast Asia, slowing growth in Japan and China, and low-price competition from South Korea. Despite facing the same trying conditions, HSIP firms still managed to enjoy stable growth in both turnover and investment. New companies are still applying to set up operations in the HSIP. The HSIP will continue to maintain its orientation towards research and development, and since land use in the HSIP is nearly saturated, the current focus of recruitment efforts is on firms that don't require much plant space—such as small but highly profitable design and intellectual property (IP) firms. The first stage of development at the Tainan HSIP has now been completed. Firms are actively being recruited, and 27 have already made plans to set up operations. Recruitment efforts at the Tainan HSIP will focus on IC, precision machinery, electro-optics, and biotechnology firms.

In 1998 the R.O.C. was the world's third-largest manufacturer of information products and the fourth largest manufacturer of semiconductors. Although Taiwan's global market share of notebook computers, scanners, wafer fabrication, and main boards continued to grow, the growth rate of the overall value of information products slowed due to product turnover, rapidly dropping prices, and intense competition.

An Advanced Rapid Prototyping and Intelligent Manufacturing System Program Promoted by the NSC

The NSC is planning and promoting many advanced technology programs to meet the needs of domestic Hi-Tech industries. Rapid prototyping (RP) and "intelligent" manufacturing have now been included among the NSC Engineering and Applied Sciences Department's key automation technology research areas. During 1998 the following four group research projects were carried out as part of the three-year program: (1) "Development of Reverse Engineering and Rapid Prototyping Systems," (2) "Intelligent Inspection and Reverse Engineering Systems," (3) "A Composite Semiconductor Manufacturing Machine with a Network Linking Function," and (4) "A Virtual Automated Semiconductor Factory."

In a time of rapidly changing markets, manufacturers must respond by making products smaller, shorter, lighter, thinner, and more complex, by shortening production cycles, and by making smaller batches of a wider variety of models. Computer-assisted design (CAD) and reverse engineering can be used to shorten design and manufacturing time, and can reduce wasted time and expense from redesign and re-manufacturing if design errors occur. On the positive side, business opportunities can be seized by getting new products on the market quickly. RP is a new technology with great industrial potential that has appeared in the wake of CNC processing techniques. RP technology combines electrical, mechanical, and optical applications, and allows prototypes to be quickly manufactured by means of a 3D CAD model of an object. In RP prototypes are made by means of automated manufacturing techniques and layering technology. The benefits of RP include lower costs, shorter product development time, faster market introduction, and more business opportunities. When a designer has access to RP parts, such tasks as modifying the part's form, inspecting its functionality, and planning mass production processes can be easily accomplished during the initial design phase. RP techniques can even be used in rapid tooling manufacturing to achieve high-speed production by first making temporary molds and then mass production molds. Because these tasks are very difficult to accomplish using conventional 2D graphic techniques, it is no exaggeration to say that RP technology is revolutionizing industry. It will certainly have a great impact on industrial design and the quick development of new products.

Have you watched the movie "Face Off"? When the two main characters in this movie exchanged their faces, RP technology was used to produce their ears. One of the main methods of reverse engineering is to scan a physical object into a computer using a 3D scanner. After modifications are made in the computer, a rapid prototyping machine is used to create a physical object by means of material addition. This type of system will have widespread applications in medicine, metal manufacturing, and the plastics industry. RP methods may be used directly for production when small batches or custom-made products are required. When mass production is required, an automated production line can then used to make large quantities of products.

In the 1997 Worldwide Progress Report, Whohler states that the market for RP machines is currently worth US$420 million and is growing at a rate of 42.6%. This rate of growth is expected to hold steady or even accelerate in the future. Taiwan must therefore work to meet future domestic and overseas demand by actively developing this technology and achieving the goal of localized RP machines.

One group project (comprising six subprojects) studying reverse engineering and RP systems was approved in 1998. Funding for this project was NT$6.568 million and participants included six professors, three doctoral students, and nine master's students. The principal investigator was Dr. Ren C. Luo, dean of the College of Engineering at National Chung Cheng University. The topics of the six subprojects were "Free Form Geometric Modeling and Adaptive Slicing Operations," "Data Transfer Applications in Rapid Prototyping," "Directive Slicing from Massive 3D Measured Point Data in Rapid Prototyping, "Establishment of CAD and RP Interfaces Using CT Scan Data," "Development of 4-axis Scanning Techniques and Application to Rapid Manufacturing Systems," and "Research on Fabrication of Photo Masks for a Rapid Photopolymer Curing System." The focus of these projects is on developing intelligent, automated rapid product fabrication systems, including rapid design, rapid prototyping, and rapid production techniques.

The NSC is also carrying out a manufacturing system research program within the field of automation; this program seeks to study holonic systems that are intelligent, autonomous, distributed, and cooperative. These systems will combine conventional hierarchical systems and new distributed autonomous agent systems, and will possess the characteristics of distribution and autonomy. Each system will have a high degree of autonomy, and with appropriate planning and control will be able to cooperate with other systems. The application of this concept to manufacturing automation can achieve the integration, rationalization, and optimization of the system as a whole, raise production efficiency, reduce costs, and create profits. Furthermore, this research also includes the development of automated, intelligent, real-time, online process monitoring and control systems that may be applied to quality control and quality assurance tasks. The techniques developed can be employed in many areas, including semiconductor fabrication, integrated circuit packaging manufacturing, and ordinary continuous manufacturing processes. Three group research projects (including 19 subprojects) were carried out in these areas in 1998. Funding was NT$26 million, and participants included 20 professors, 16 doctoral students, and 39 master's students.

In addition to cultivating many research specialists and raising Taiwan's academic standing, these projects also resulted in the development of many highly-competitive products, key industrial technologies, and advanced systems equipment. Technology transfers from the projects fostered mutually-beneficial interaction between industry and the academic community. High-tech industry will play a major role in the nation's future development. The use of intelligent automated manufacturing technologies will deliver greater benefits at a lower cost and help Taiwan join the ranks of advanced high-tech industrial nations.

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