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The Development of Tainan Science-Based Industrial Park and the Tainan International Sci-Tech Metropolis

I. Concepts and Objectives

The Hsinchu Science City and Science-Based Industrial Park (SIP) has unquestionably been the most outstanding example of the use of high-tech industry to stimulate Taiwan's economic growth and urban development. The historic mission of the "Tainan Science-Based Industrial Park and Special Development Zone" is to build on Hsinchu's success and deliver even greater economic and social benefits by staying at the forefront of the 21st century's emerging information society.

Relying on more than a decade of experience at the Hsinchu SIP, the Science-Based Industrial Park Administration has proposed a far-reaching yet feasible overall development plan for the Tainan SIP and special zone. This plan takes into account the current state of Taiwan's industries, the experiences of the Hsinchu SIP, and the current level of development in the Tainan area. Its ultimate goal is to establish a world-class "metropolis of science and technology" that is ready for the challenges of the next century.

II. Development Strategies

To achieve the goal of building a 21 st century metropols of science and technology, the SIP Administration has devised the following ambitious development strategies to serve as guidelines for the establishment of the Tainan SIP:

1. Establishing a regional development framework offering broad social benefits

This strategy seeks to link the Tainan SIP with existing urban areas including the nearby towns of Hsinshih, Shanhua, and Anting. Resources will be integrated and the area's current foundation built upon to create a "secondary regional center" capable of stimulating growth and attracting new residents. The need to maintain a mutually-beneficial relationship between the urban development zone and surrounding rural agricultural areas will be fully taken into consideration. A well-planned urban transportation network will link towns and cities, broadening the scope of the region's development.

2. Responding to the needs of high-tech industries and supporting firms by increasing land use flexibility

Based on experience gained at the Hsinchu SIP, the chief characteristics of Taiwan's high-tech industries (including computers and computer peripherals) include the need to continuously expand plant facilities and also to stay in close contact with upstream and downstream firms. Therefore the development plan for an optimal sci-tech city must maintain a high degree of flexibility in land use and also place emphasis on the inseparable relationship between urban development and the growth of high-tech industries. Such a plan can accommodate the characteristics of Taiwan's industries by allowing adjustments in land use policies in response to changes in industrial development trends. Key aspects of this strategy include:

- Leaving land in reserve for future expansion of the SIP.
- Leaving land in reserve for the growth of satellite industrial parks.
- Giving supporting industries priority access to land in neighboring urban planning districts.

3. Providing a high quality environment for development

Creating and maintaining a high quality urban environment requires adequate, balanced attention to both current needs and future developmental trends. This strategy is based on experience gained at the Hsinchu SIP and incorporates the most up-to-date urban development policies. Its goal is to establish a first-rate development environment by providing the following main elements:

- A wide array of healthy and environmentally-friendly residential options.
- A basic educational environment with an international outlook.
- A cultural atmosphere blending both international and local characteristics.
- Friendly and attractive leisure and shopping districts.
- A regional information network linked with the National Information In-

frastructure (NII).
- Incentives and encouragements for the establishment of training and R&D organizations.

4. Establishing an urban model for sustainable development in the 21st century

Creating a model for sustainable development in the 21st century is a major challenge facing urban planners around the world. The chief goal of this model is to determine a scope and direction of development that can be sustained by resources available in the environment while also meeting the need of future urban areas for high efficiency and a high standard of living. Basic strategic measures will include:

- Managing and maintaining a certain level and direction of urban development.
- Creating the framework for a permanent balance between technology, culture, and the ecology.
- Constructing a high-performance, energy-efficient, low-pollution transportation system.

III. Framework for Development

Located on the periphery of the more well-developed parts of the Tainan area, the "Greater Tainan International Metropolis of Science and Technology" will serve as a demonstration project showing how sustainable urban development and robust economic growth can be achieved. Taking into consideration environmental characteristics of the SIP, special development zone, and neighboring areas, the sci-tech city's preliminary development framework will be based on the previous development strategies and will encompass the following three major development zones:

- A technological and cultural urban development zone served by mass transportation.
- The Yenshui Creek park and community development nucleus.
- The Tsengwen Creek country living zone.

1. A technological and cultural urban development zone served by mass transportation

By incorporating existing communities, built-up areas, and the under-construction Tainan SIP, a relatively high density urban development zone will grow up along both sides of county roads 117 and 118. In the built-up areas of Hsinshih and Shanhua, and near the eastern entrance to the SIP, plans have been made to establish multi-function town centers providing shopping, cultural, entertainment, and other services. These town centers will constitute a high-density urban development hub that will facilitate the creation of a mass transportation system. This urban hub will effectively utilize the land, human resources, and social service infrastructure of existing urban planning districts to meet the needs of the rapidly-growing SIP. It will also serve to channel the wave of secondary development that the SIP's growth will trigger, including the construction of residential and commercial areas and the growth of supporting industries. The urban hub will also guide the growth and renovation of peripheral urban planning districts.

Vigorous efforts will be made to encourage various types of development within the urban zone. These types of development will include cultural facilities, shopping and entertainment streets, commercial enterprises, industries supporting the SIP, urban leisure/recreational facilities, and an array of high quality "intelligent" residential communities. The urban zone will also possess an advanced, high-tech infrastructure including fiber-optic communication cables, an NII-linked regional information network, an international school, and a local magnetic-levitation transit system built on the beds of the old Taiwan Sugar railway lines in the area.

2. The Yenshui Creek park and community development nucleus

The wetlands and fishponds—a typical feature of this area—on both sides of Yenshui Creek can be adopted as an ecological nucleus and act as the green "lungs" of the entire science city. Like New York City's Central Park, this ecological nucleus will serve as a key element in the area's sustainable development framework. The forested ecological nucleus will feature a beautiful and tranquil environment, and will provide the urban development zone with a greenbelt.

In addition, a number of the area's unique cultural or natural landmarks will be developed in a low-key, non-destructive manner as parks with a natural or historical theme. The following are some proposals for this type of park:

- The Niaosung cultural history park
- Scenic wetlands conservation areas
- Fishpond recreation areas
- Scenic hydrological regulation lakes
- Urban forest parks

3. The Tsengwen Creek country living zone

The farmlands on the southern shore of Tsengwen Creek and their well-developed irrigation systems will be preserved in the current plan, and will continue to project a harmonious and timeless sense of place. In conjunction with rural improvement programs, farming communities on the periphery of the high-density urban development zone will see the development of low-density country living communities meeting international standards. The rural areas and their new communities will constitute a country living zone and provide a residential alternative for SIP employees.

In accordance with this developmental framework, the benefits and potential of the Tainan SIP will provide the Tainan area with a priceless, lasting asset. The Tainan SIP will also form the heart of a sophisticated and highly competitive technological metropolis.

IV. Conclusion

In order to meet the future developmental needs of the Tainan SIP, the Tainan county government has designated approximately 2,000 hectares of land in the vicinity of the SIP a "special development zone." In accordance with legal procedures, the Taiwan provincial government has now been requested to obtain the Executive Yuan's approval for this zone. The following are the special development zone's functions:

- Providing land for the future expansion of high-tech firms located in the SIP.
- Providing land for the construction of regional and SIP infrastructure including access roads and drainage systems, etc.
- Providing land to meet the residential needs of SIP employees.
- Providing land for supporting facilities, research organizations, restaurants, commercial enterprises, shops, and other services.

Besides continuing to develop the Tainan SIP, the NSC Science-Based Industrial Park Administration will also work to establish the Greater Tainan International Metropolis of Science and Technology by cooperating with the Tainan county government in developing the special development zone.

Advanced Research at the SRRC on Magnetic and Strongly Correlated Electron Systems Using Synchrotron Radiation Spectroscopy.

Since the Synchrotron Radiation Research Center's (SRRC) accelerator was completed in 1993, one of its chief tasks has been carrying out leading-edge research utilizing synchrotron radiation. One of the most important research projects underway at the SRRC is the Integrated Research Project, entitled "Investigation of Magnetic and Strongly Correlated Electron Systems Using Advanced Synchrotron Radiation Spectroscopy".

Magnetic and strongly correlated electron materials exhibit fascinating phenomena, such as high temperature superconductivity, giant magneto-resistance of magnetic multilayers and manganese perovskites. These materials have received great interest in their fundamental physics and technological applications. In spite of the enormous worldwide effort that has been devoted, the mechanisms of these phenomena are far from fully understood yet. To guide the further development of these important new classes of materials, a fundamental understanding of their mechanisms is indispensable and has become a major challenge to physicists and material scientists. The goal of this proposal is to utilize advanced synchrotron radiation spectroscopic techniques in order to probe the electronic and magnetic structure of magnetic and strongly correlated electron systems.

Synchrotron radiation spectroscopy is a very effective tool for probing the electronic and magnetic structure of matter. In particular, it helps reveal the microscopic mechanisms responsible for the fascinating phenomena exhibiting in magnetic and strongly correlated electron materials by using various types of undulators and advanced photon and electron analyzers. Ultra-high resolution angle-resolved photoemission, helicity- and spin-resolved photoemission, high resolution x-ray absorption, x-ray fluorescence emission, and soft-x-ray magnetic circular dichroism (SX-MCD) are very important synchrotron radiation spectroscopic techniques. We plan to consolidate relevant expertise in the SRRC to develop and to utilize leading-edge synchrotron radiation spectroscopic techniques.

This proposal has the following three characteristics:

1. Completeness and Uniqueness

To our knowledge, there is no other project in the world which combines magnetic circular dichroism, ultra-high resolution angle-resolved photoemission, and helicity- and spin-ressolved photoemission.

2. Leading-edge and Advanced Experiments

We will use a third generation SR storage ring and advanced synchrotron radiation spectroscopic techniques to carry out pioneer research.

3. Broad Research Topics

Our research topics includes HTSC, non-metal to metal transitions of ultrathin films, heavy-fermion systems, and giant magneto-resistance of magnetic multilayers and manganese perovskites, etc.

Establishing Mammalian Gene Knockout Technology in the R.O.C.

The use of gene knockout technology on mammals was first reported in 1986. In the 90s this technique has been widespread use in sophisticated bioscience experiments. So-called "knockout mice" refers to mice in which a specific gene has been disrupted in every cell in their bodies. Besides aiding the study of gene functioning, such mice are also playing a valuable role in research on disease and new methods of treatment. Gene knockout technology is now providing new scientific insights and data in such fields as neurology, immunology, oncology, and behavioral science.

Knockout mice are created through a scientific process that alters the genetic code of living mice. With NSC support, the investigator of one of the R.O.C.'s first gene knockout projects spent the year before last in France learning about the various manipulations involved. This project investigator began attempts to create knockout mice upon her return to Taiwan, and has successfully completed the chimeric mice stage. To put it in the simple terms, the gene knockout technique begins with gene targeting. In gene targeting the segment of the gene to be damaged is modified using genetic engineering technology such that the specific gene is interrupted. The segment is then inserted in an embryonic stem cell using an electrode method. By selecting embryonic stem cells in which homologous recombination of genetic material has occurred, it is possible to obtain cells in which the altered gene replaces the chromosomal counterpart and destroys its funtion. The next step is the use of microinjection techniques to inject these cells into blastocysts and then implant the blastocysts in a foster mother mouse. Mice that are born as a result of this procedure are known as chimeric mice. Breeding chimeric mice with normal mice produces offspring in which a single set of the gene in question has been damaged (heterozygotes), and breeding these offspring among themselves will produce mice in which both sets of the gene have been knocked out (homozygotes).

Ethical concerns place serious constraints on human experiments, and it is difficult to obtain animals in which natural mutations have led to genetic diseases analogous to those seen in humans. However, since gene knockout technology allows the creation of mice with the same genetic diseases that are found in humans, it provides a way out of this dilemma. These mice can then be used to investigate disease mechanisms and develop new medicines and treatments. In particular, genetically-engineered mice are ideal subjects for the study of new gene therapies. Now the technique of creating knockout mice is gradually taking root in the R.O.C.

Artificial Intelligence in Experiment Design and Quality Control —The Development of a Neural Network Quality Control Software Product

The rapid development of industrial technology and fierce global competition have led to shorter and shorter product life cycles in recent years. Thus the development of new products has become an issue of paramount importance to many industrial firms. Moreover, consumers' increasing demand for high quality has forced industry to pay great attention to delivering consistently high product quality. The NSC Engineering and Applied Sciences Department has addressed industry's product development and quality control needs by bringing together upstream, midstream, and downstream organizations to participate in the joint development of a commercial artificial intelligence software system that will help firms in Taiwan to grow and compete in the global marketplace. Among the enterprises and individuals involved in this project are the software development firm ACS Inc., the downstream firms TSMC Inc., Chinese Petroleum Corp., China Steel Corp., and China Glaze Inc., and several researchers from the Chemical Engineering Department of National Tsing-hua University who specialize in the fields of artificial intelligence, formula design, and quality control.

Artificial intelligence technologies such as artificial neural networks (ANNs) have become synonymous with a new generation of intelligent products. For instance, "neuro-fuzzy" electric appliances are now widely used throughout society. While participating in an NSC-sponsored research project on the development of artificial intelligence, several specialists from the Chemical Engineering Department of National Tsing-hua University discovered that ANNs are particularly suited to product development and quality control. The basic principle behind such applications is to link existing ANNs in a series and perform analysis using information theory developed in the 1970s. The result is a system that can make the best possible conjecture using the least amount of data. It just so happens that such a system is ideal for product development and quality control work.

Software developed in this project helped TSMC derive optimal operating conditions for a plasma etching process in little more than 20 tries. It would be impossible to get this result using conventional experiment design methods. In addition, China Glaze successfully used the software to find a six-variables formulation for a certain pigment in only 64 tries. Conventional experiment design methods might take more than 500 tries to deliver the same result, and might find it impossible to converge on the best results. Not including time wasted, each try costs China Glaze several thousand NT dollars. The software was also used by China Steel to predict the silicon content of molten iron in its blast furnaces; after it installs control measures, this application will China Steel improve its economic efficiency. Finally, China Petroleum is using the system to predict the octane number of gasoline at its Talin plant, and is currently purchasing instruments that will allow it to institute more efficient blending methods.

Over the last two years, the development and trial use of this software has already delivered notable benefits. During the third year, the project will devote all its efforts to the commercial packaging of this product. We believe that the successful development of this software will certainly make a significant contribution to the nation's industrial progress and quality upgrading.

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