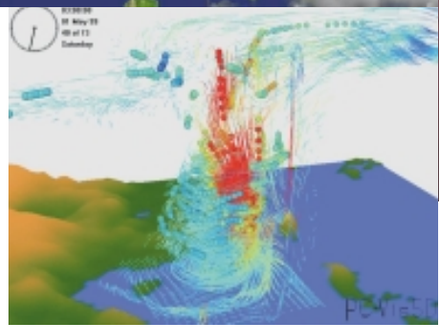
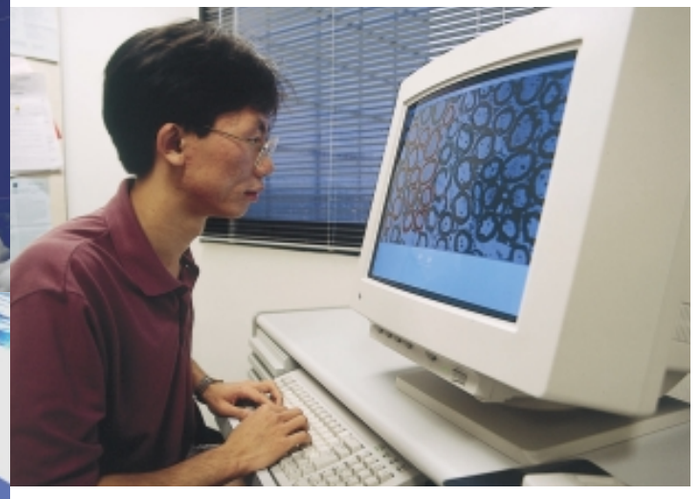




A research university in Hong Kong. At first this might have seemed a contradiction: the painstaking and often slow process of discovery and the short-term, quick-money outlook of Hong Kong.

However, in the early 1990s, history was pushing at the door and new economic realities were altering what had gone before. Soon Hong Kong would return to China, with few traditional industries left on its side of the border. Fresh ways were called for.

Developing economies use established technologies from developed countries but are competitive because of cheap labor and land costs. Newly industrialized economies search for breakthroughs developed elsewhere, and then do their own applied R&D to get new products quickly on the market. Advanced economies are involved in all aspects of technology transfer and invest large amounts in academically oriented basic research.

Hong Kong was caught between a developing and an advanced economy. Taiwan and Singapore were already spending between 1.5% and 2.5% of their gross domestic product on research. Hong Kong was allocating no more than 0.1%.

"When we first came, the Government spent almost nothing on research," says the President, Professor Chia-Wei Woo. Indeed it spent less on research in all Hong Kong institutions than one department — "not even a school" — in a top US institution.

Discovery Channels

What does a top-class research university actually mean? Professors who talk among themselves about opto-electronics, who construct the underlying theories of nanostructures, and write papers on the latest biotechnological advances for other academics to appreciate? How does that really help move a society on?

It helps a society to think, to be creative, to enrich itself culturally, and to advance on all fronts. The academic discussions, papers, and debates may seem to have their own language and live in a world apart. Yet it is here that revolutionary breakthroughs are born and, once such discoveries are applied and transferred to the marketplace, our future lives are shaped.

Basic research is the source of new knowledge. From basic research stems applied research, which leads on to product and process development,

prototyping, commercialization, production, packaging, marketing, and sales — sometimes in sequence, and sometimes in parallel.

With one eye on academic excellence and the other on public service, one foot in Hong Kong and the other in the outside world, HKUST set out to ensure that first-rate research had a new home.

Prof Leroy Chang

Scaling the Heights

Top-class research requires top-class minds to generate ideas. A main strength of HKUST in its first 10 years has been recruiting the faculty necessary to ensure creativity. They, in turn, have produced their own personal transfer process, spreading excitement about discoveries among their postgraduates and undergraduates, who will either head into research careers themselves or transport enthusiasm into the wider community.

"If you come back at night, you will see people working in the laboratories. They are already well established and gain no extra compensation," says Professor Woo. "What drives them is intellectual curiosity — the self-generated pressure of wanting to learn more, understand the world, and excel. Such attitudes rub off."

Professor Leroy CHANG, former Dean of Science and Vice-President for Academic Affairs, spent seven years at HKUST before retiring in 2000. An outstanding scientist with 30 years' experience as a leading researcher at IBM, Professor Chang is confident about the University's ability to generate a strong culture of research. "One overall strength that HKUST has is its faculty. No question about it, the University is really unique in this area."

The University's research programs follow two general principles, Professor Chang explains. "Whatever we do, we want to be at the forefront of all the other leading universities in the world. Secondly, we like to add local color. For example, we emphasize the use of modern biotechnological knowledge to look at traditional Chinese medicine. In our Business School, the major goal is to do leading research that applies anywhere in the world and, in addition, we focus on China business and management."

Prof Michael Loy

To enable such leading research to take place, the right environment and encouragement are vital, especially for younger faculty. As Professor Michael LOY, Dean of Science, points out: "When I talk to young faculty, I always try to stress that they should aim for the peaks in research. The valleys provide the base from which you can head for these peaks; the valleys should not be the goal."

Research Institutes

- Advanced Manufacturing Institute
- Biotechnology Research Institute
- Europe Institute
- Hongkong Telecom Institute of Information Technology
- Institute for Environment and Sustainable Development
- Institute of Integrated MicroSystems
- Institute of Nano Science and Technology
- Sino Software Research Institute
- Transportation Institute

Research Centers

- Advanced Cement-Based Building Products Cooperative Research Center
- Advanced Composite Materials for Infrastructure Repair Cooperative Research Center
- Advanced Electronic Packaging and Assembly Cooperative Research Center
- ATM/IP Telephony Solution Cooperative Research Center
- Automation Technology Cooperative Research Center
- Center for Asian Financial Markets
- Center for Coastal and Atmospheric Research
- Center for Cultural Studies
- Center for Display Research
- Center for E-Commerce
- Center for Economic Development
- Center for Energy and Thermal Systems
- Center for Experimental Business Research
- Center for Medical Diagnostic Technology
- Center for Scientific Computation
- Center for Wireless Information Technology
- Construction Research Center
- Consumer Media Center
- Cooperative Nasopharyngeal Carcinoma Research Center
- Cooperative Research Center for Soluble Receptor Biology
- Cooperative Research Center in Active Matrix Organic Light Emitting Diode Displays
- Cyberspace Center
- Hainan Center
- Hang Lung Center for Organizational Research
- High-Throughput Drug Screening Center for Traditional Chinese Medicine
- Hong Kong Bioinformatics Center
- Internet Switching Technology Center
- Molecular Neuroscience Center
- Multimedia Technology Research Center
- Optical Fiber Lighting Cables Cooperative Research Center
- Shui On Center for China Business and Management
- South China Research Center
- Survey Research Center

Central Research Facilities

- Advanced Engineering Materials Facility
- CLP Power Wind/Wave Tunnel Facility
- Computer Aided Design and Manufacturing Facility
- Geotechnical Centrifuge Facility
- Materials Characterization and Preparation Facility
- Microelectronics Fabrication Facility

Crossing the Boundaries

One of the questions that tax universities is the balance between basic and applied research. The creation of new knowledge that comes with basic research is a powerful stimulant to both students and faculty.

When a practical use for that knowledge is found and transferred out of the university into society, the community benefits directly. HKUST, in line with its mission to promote Hong Kong's economic and social development, has always placed a good proportion of its emphasis on applied R&D.

The University decided that one way of achieving its goals was to set up research institutes and centers that cut across school and departmental boundaries. From multidisciplinary research often come the sparks that ignite innovative technologies, especially when in collaboration with local industries.

Areas the University initially prioritized in order to combine groundbreaking research with Hong Kong's needs included biotechnology, information technology, software, microsystems, materials, environmental protection, and economic transition.

The framework proved highly successful. By 2001, it had grown to a total of nine institutes and over 30 research centers encompassing such diverse areas as biotechnology, China business and management, coastal and atmospheric

studies, cyberspace, nanostructure science and technology, South China, and transportation.

Financing New Knowledge

Funding for research comes from the Hong Kong Government, the private sector, and foundations. In addition, the University uses a portion of its operating budget to support research projects it sees as in keeping with its objectives and as of high impact.

In 1991–92, the University obtained research funding totaling HK$40.5 million. By 1999–2000, the amount had topped HK$285 million.

In 1994, soon after the Government established the Research Grants Council, HKUST became the most successful of all Hong Kong's higher education institutions in projects accepted, success rate and per capita funding awarded by the Council. It has maintained its leading position ever since.

Equipped for Success

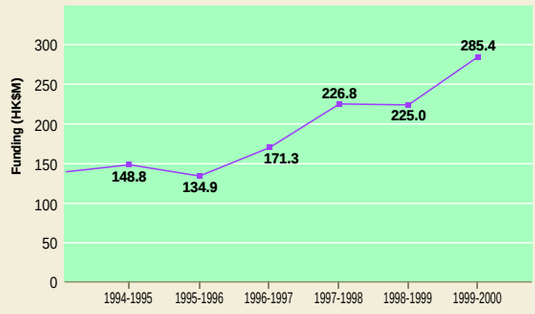
A science and technology research university requires many specialized facilities to enable its academics to do their work. In the late 1980s, Professor Woo and his team of academic advisers had a long list for the planners:

We need clean rooms, constant temperature rooms, negative pressure rooms. "Movers and shakers" — engineers whose research work creates high amplitude vibration — should have rooms at the bottom of buildings so they can be isolated from other structural components. "Stinkers" — those scientists who produce nasty (though harmless) smells — should be placed at the top of buildings for ease of ventilation. We must have clean corridors where all can walk, and "dirty" corridors through which equipment and potentially dangerous materials can travel.

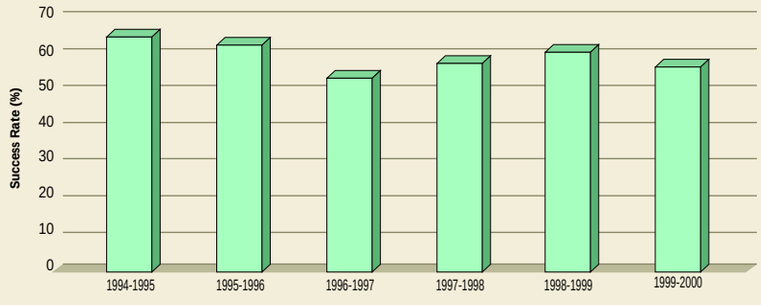
The result was 50,000 square meters of laboratory space at HKUST, and five miles of laboratory benches. Inside these laboratories, an impressive array of equipment with long and exotic names has been assembled over 10 years.

A Hong Kong Government allocation for start-up equipment got the University's world-class facilities underway, with individual faculty members' research reputations playing a large part in gaining donations of equipment worth millions of dollars from multinational corporations. Grants from foundations have also helped considerably.

HKUST academics have not been the only beneficiaries of its advanced equipment. The University has made its Central Research Facilities available to staff from other tertiary institutions and professionals from the community — a big boost for researchers throughout Hong Kong, who would draw the community faster into a technology-based society.



Total Annual Research Funding

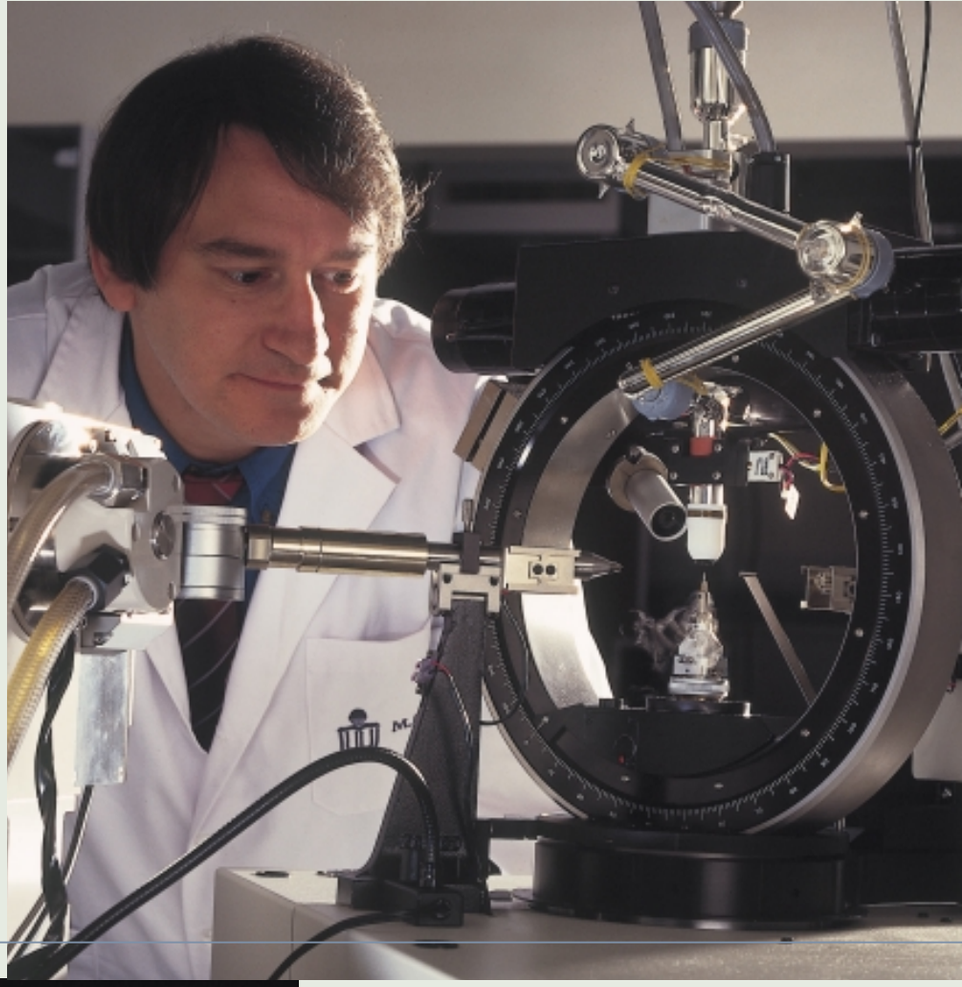


Success Rates in RGC Funding

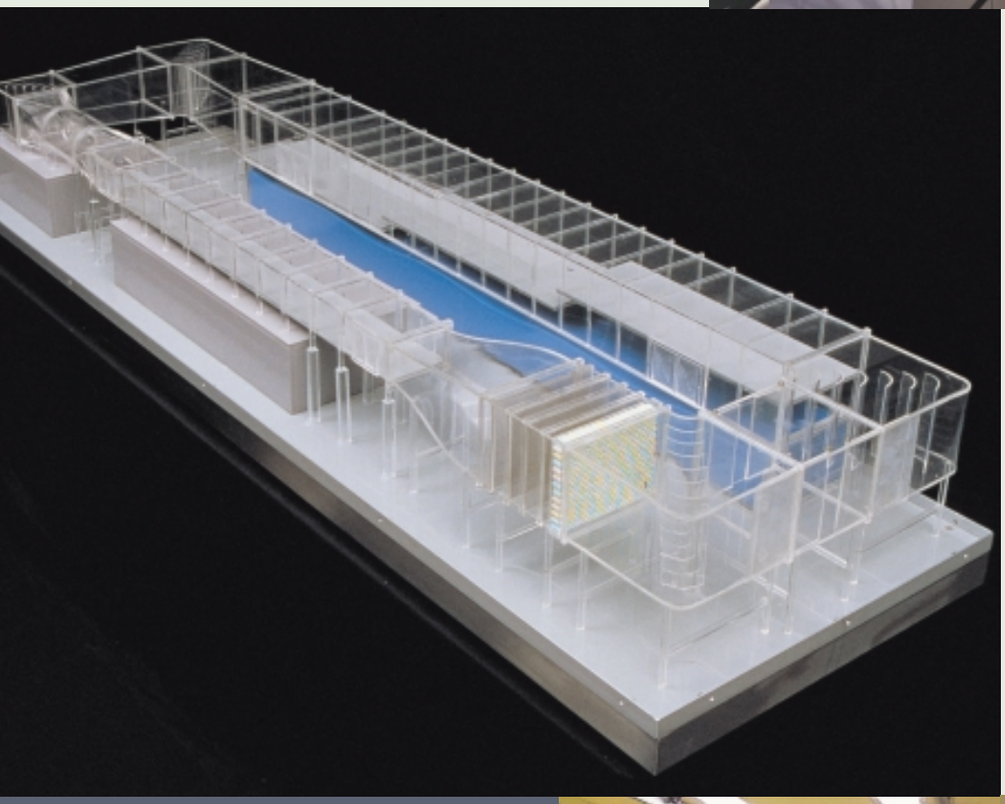
Central Research Facilities

The arrival of HKUST has increased Hong Kong's capacity for research enormously. Much of the equipment is unique in the region. Previously, businesses and researchers would have had to go overseas; now they can make Hong Kong the home of world-class discoveries. Here are a few examples.

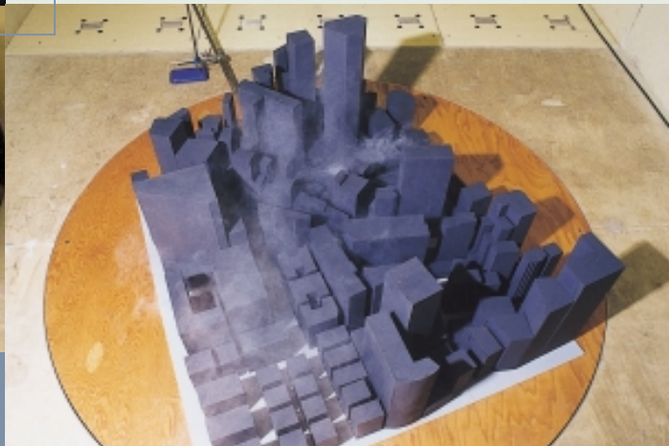
CIRCUIT TRAINING: *It is "no go" without your "bunny suit" at the Microelectronics Fabrication Facility — the first laboratory of its kind in Hong Kong. Producing silicon chips requires the atmosphere to be cleaner than clean. Special air, water, vacuum, and chemical systems ensure that the five fabrication modules are kept in pristine condition.*



MATERIALS WORLD: *The Materials Characterization and Preparation Facility is used extensively by science and engineering researchers. Helping them on their way to new knowledge are a field emission scanning electron microscope; a high-resolution transmission electron microscope; an atomic force microscope; imaging SIMS systems for surface and depth profiling analysis; and Asia's first single-crystal X-ray diffractometer.*



GUST IN TIME: *The CLP Power Wind/Wave Tunnel Facility — the only one in the region — allows front-line research into wind and wave engineering, and pollution dispersion problems. The facility is available to Hong Kong and the region's construction and engineering industries, and to environmental researchers.*

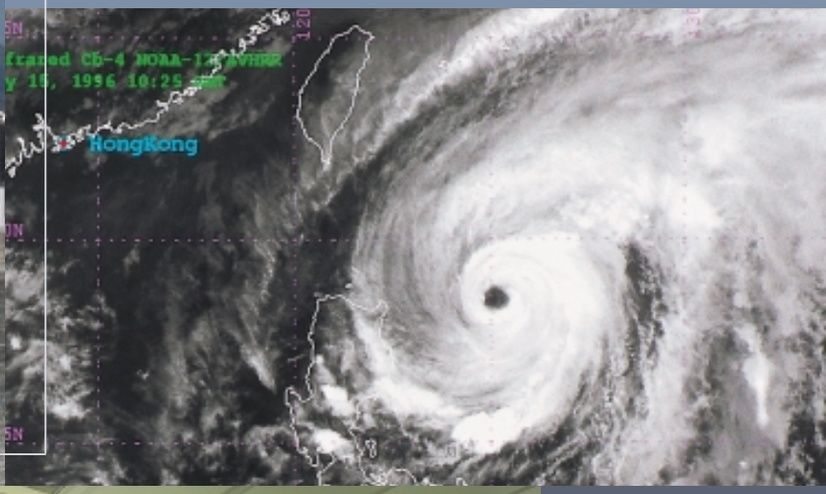


A FINE LINE IN DESIGN: *Research supported by the Computer Aided Design and Manufacturing Facility has had direct bearing on design and manufacturing industries. Its state-of-the-art equipment includes a three-dimensional laser scanning system, robots, and a rapid prototyping machine.*

THE BIG SHAKE-UP: *At the multimillion-dollar Geotechnical Centrifuge Facility, researchers are able to simulate earthquake motions with a special bi-axial shaking table — a world first. Rain-induced land-slides, tunneling, deep excavation, and settlement of reclaimed land are among the many other geotechnical research areas to benefit from the Facility.*

Machine Power

SEA CHANGE: *With a HK$4.39 million grant from the Croucher Foundation, HKUST can tap into messages from on high via Asia's first ocean color satellite receiving station. Signals from meteorological satellites can be used to monitor biological and physical patterns in the South China Sea and develop long-term environmental protection for the Pearl River Delta.*



CALCULATED MOVE: *No need to worry over mega projects, with a 140-processor Intel Paragon supercomputer on hand. With its help, researchers in computer architecture and scientific computation could solve large-scale problems not possible on ordinary computers in the mid-1990s.*

"People come here to accomplish, to do things. They have set the pace for Hong Kong."

Prof Otto Lin

Culture Shock

The research atmosphere incubated at HKUST has helped alter the pattern of university life in Hong Kong. One of the prime movers was Professor Eugene WONG, who became Vice-President for Research and Development at HKUST in 1994.

As a former Associate Director of the White House Office of Science and Technology, Professor Wong had played a major role in paving the way forward for the development of the information superhighway in the United States in the early 1990s. At HKUST, he was determined to lay the foundations for another revolution among the faculty, one that would lead to stronger links between university research and the commercial world. "This is where we have the opportunity to be most innovative," he said shortly after his arrival.

Prof Eugene Wong

Professor Wong's plans, coupled with the inner drive of HKUST's faculty, have altered the Hong Kong research landscape.

"Having a university job used to be a very comfortable thing," says Professor Otto LIN, who took over from Professor Wong in 1997 and who had earlier spent six years as President of the world-renowned Industrial Technology Research Institute in Hsinchu, Taiwan. "You could be laid back after your lectures. If you wanted to do your research, fine, you did it at your own pace.

"However, HKUST people are accomplished scientists with distinguished records in their own fields. They are eager to achieve; they want to demonstrate their capability. The biggest impact HKUST has had on Hong Kong is to set the pace."

Soon HKUST's faculty were producing groundbreaking scientific research in many different fields, and their successes have brought international recognition to Hong Kong.

Patents and Mainland Grants

HKUST's innovative research has helped the University gain patents for its work. Along with recognition of the originality of the research, a patent is evidence of an invention's commercial potential. With a patent, HKUST can license the invention to others, bringing a return on its research investment.

In 1994, three years after opening, the University gained its first US patent.

By 2000, HKUST had been granted 26 patents, with over 45 more pending, in areas ranging from bioscience to mechanical engineering to the environment.

In 1997, further recognition of HKUST's research capabilities came from an unexpected source as the University secured Hong Kong's first — and only — grant under a major Chinese Government research initiative known as the "863" program. The 6.5 million yuan project called for an offshore environmental monitoring system to be built at the mouth of the Pearl River, under the leadership of Professor Jay-Chung CHEN, in collaboration with Zhongshan University.

In 1999, Professor Jun GU was asked to lead a nationwide project on computing theory and basic algorithms, with a budget of 67 million yuan, under China's ambitious new "973" research program. A year later, Dr Qiang DU was asked to head another multimillion-yuan "973" project in information technology involving large-scale scientific computation. These are the only "973" Chief Scientists appointed outside the Chinese Mainland.

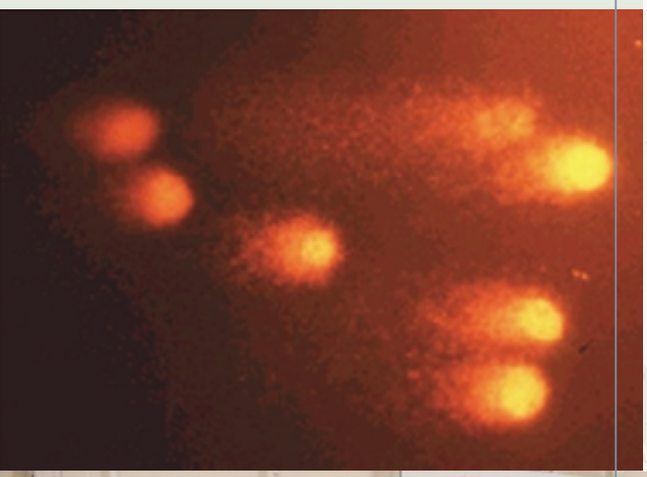
Future Moves

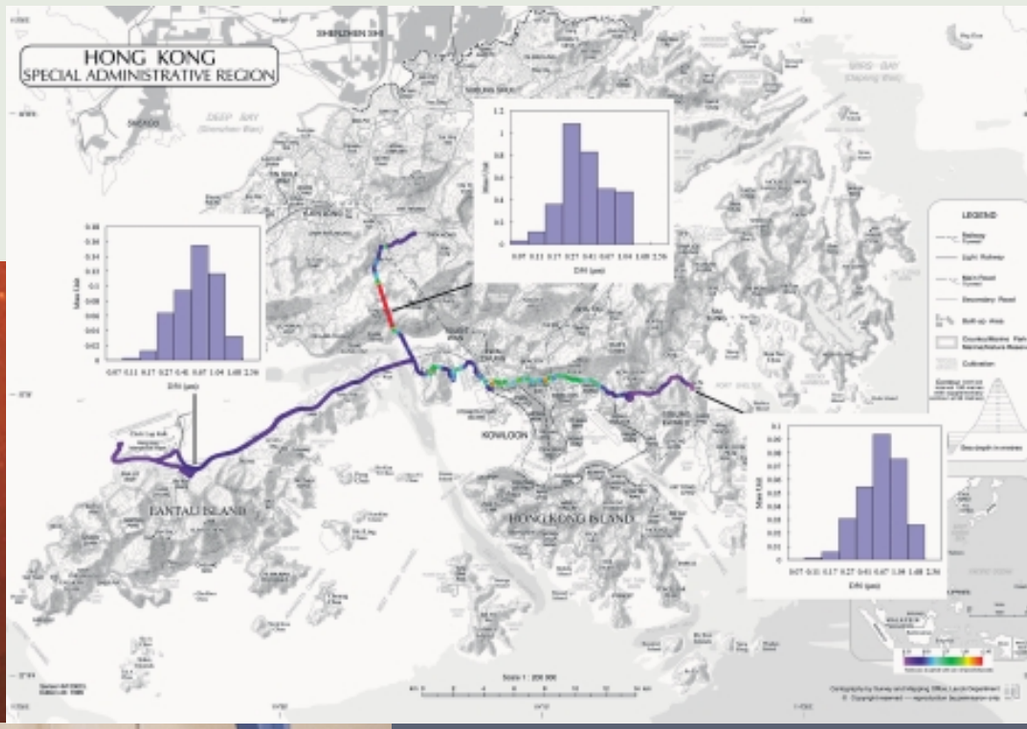
HKUST wishes to go where no one has gone before. Throughout the first 10 years, it has succeeded many times. These are just some of the University's many pioneering inventions and achievements that have pushed the community forward and turned the world's eyes on Hong Kong.

CREST OF A WAVELENGTH: *In 1994, Prof George K L Wong, together with Mainland researcher Prof Chuangtian Chen, set a new world record for the shortest wavelength of deep ultraviolet laser radiation (184.7nm) generated from a nonlinear optical crystal. Their work has pushed forward basic research and has diverse potential uses ranging from surgical procedures to telecommunications systems. "The shorter the wavelength, the greater the miniaturization possible," says Prof Wong.*

NET WORKING: *Prof Vincent Shen was a man with a grand plan when he helped the University launch Hong Kong SuperNet, the first licensed Internet Service Provider in Hong Kong, in 1993. He wanted to make the Internet more accessible — and he rapidly succeeded. SuperNet proved a catalyst for the Internet industry in Hong Kong and went on to become recognized as one of Asia's best ISPs.*

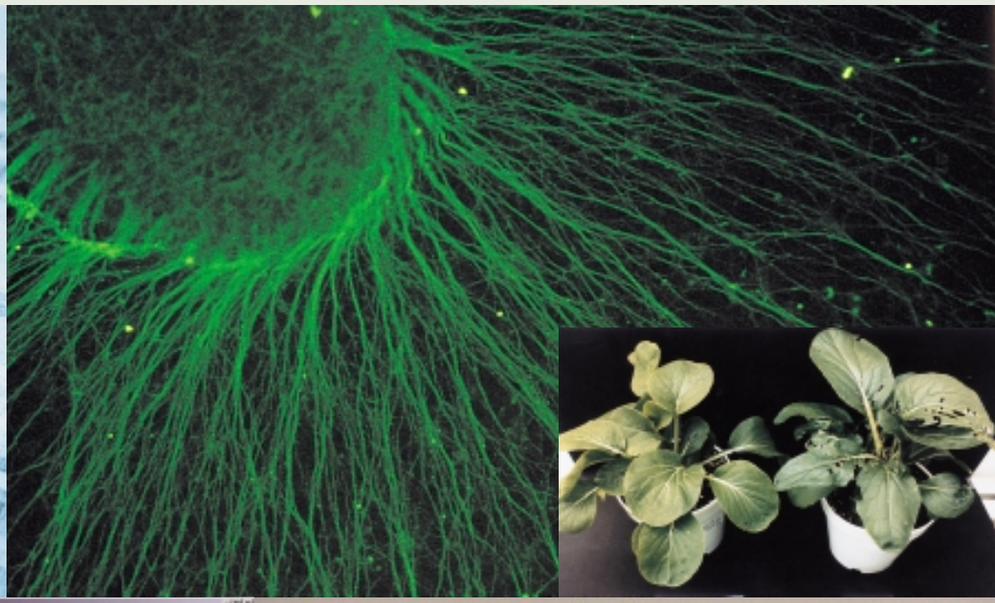
BAD AIR DAY: *Working together with US scientists in 1994, HKUST researchers carried out the first air quality measurements taken in Hong Kong on behalf of the Environmental Protection Department. Since then, the University has made significant progress in monitoring air pollution and studying its impact on human health.*

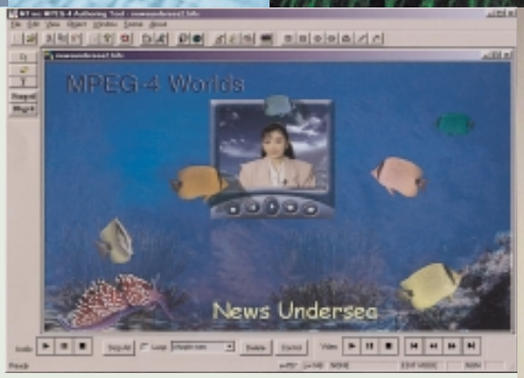


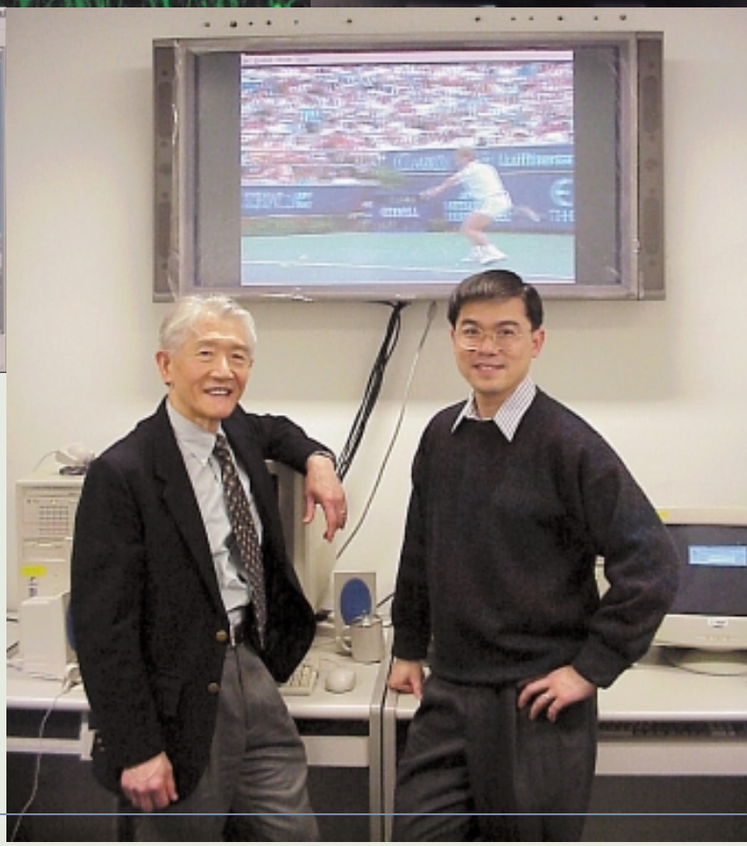


BUILDING BLOCKS: *Dr Zongjin Li's "bendy" concrete took shape in 1998 after four years' hard work. His invention can absorb impact and resist cracking better than regular concrete and is cheaper to produce. It is also highly fire resistant.*

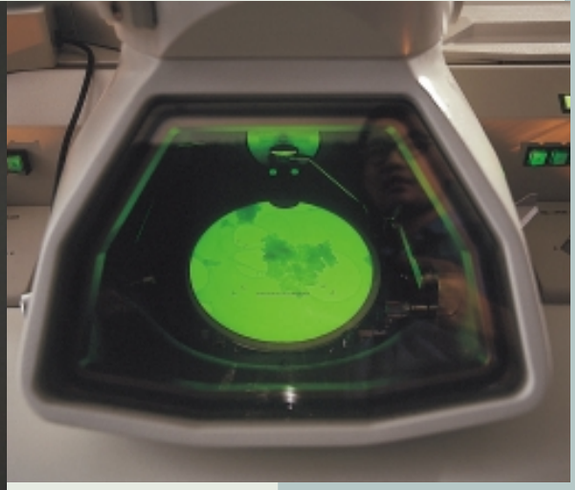
HEALTHY OUTLOOK: *To assist in understanding and spreading the use of traditional Chinese medicine, HKUST researchers have developed methods of identification, quality assurance, and standardization using genechip technology.*



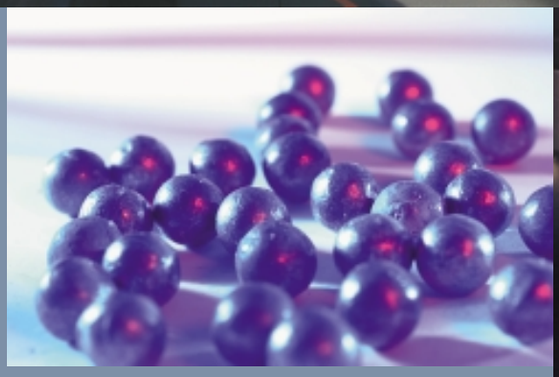




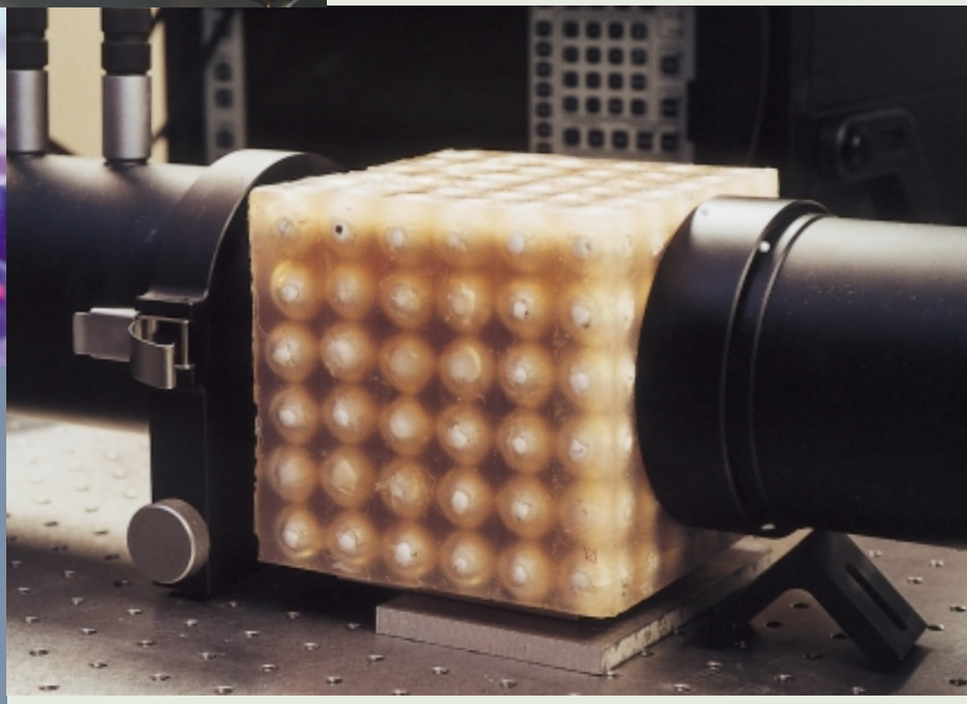
PICTURE THIS: *After fierce competition from around the world, Prof Oscar Au, Prof Ming Lei Liou and research associate Alexis Tourapis's novel video compression technology was accepted as a component of MPEG-4, the international standard in multimedia applications, in Spring 2000. The researchers' algorithm provides the speed and visual quality to bring Web television and third-generation mobile communications out of the future and into the present. It was the first time technology produced in China had been accepted by the Motion Picture Experts Group (MPEG).*



SMALL WORLD: *Dr Zikang Tang and Dr Ning Wang's fabrication of the world's smallest single-walled carbon nanotubes (0.4nm) has opened up applications in electronics, information technology, and biology. Tiny nanotubes, regarded as the materials of the future, are useful in producing microcomputers and ultra-thin televisions.*



SONIC BOOM: *Noise rage may soon be a thing of the past, thanks to a new clan of resonant sonic materials invented by Prof Ping Sheng and his team. These materials can be tuned to reflect sound waves of specific ranges. They are particularly effective at blocking out low frequency noise and can be used to develop sound shields for highways and interior soundproof partitions 10 times thinner than conventional insulating materials.*



Serious Business

HKUST's dynamic research culture stretches beyond scientists and laboratories. In the School of Business and Management, faculty are hard at work creating a special niche in Asia, and attracting international attention for the quality of their basic and applied research.

When the School was launched in the early 1990s, soft economic conditions in the United States made HKUST an attractive draw for top people. The founding team drew in more leading researchers and the School rapidly developed international strongholds in fields such as financial services, China business and management, electronic commerce, and global supply chain management.

Prof Yuk-Shee Chan is pleased to see the School of Business and Management rising to world status.

Research work has seen in-depth analyses of Chinese accounting reforms and standards, and investigations into management practices in Chinese cultural settings; as well as contributions to the formulation of vital economic policies in Hong Kong, with studies of the linked exchange rate and retirement protection. In 1998, the Center for Experimental Business Research, the first empirical research center in Asia, was established. A year later, HKUST was ranked the top university in East Asia in terms of economics research productivity by the US professional journal *Economic Inquiry*.

"The research faculty in the School is first rate," says Professor Yuk-Shee CHAN, founding Dean of Business and Management. "We are recruiting and getting the attention of the people in the top research schools. They know that the HKUST Business School is a serious player."

A Different School of Thought

In the School of Humanities and Social Science, interdisciplinary research projects have brought new insights into social, political, historical, linguistic, and

Prof Hsi-Sheng Ch'i

Students explore Hong Kong history on a field trip organized by the South China Research Center of the Division of Humanities.

philosophical issues in Hong Kong, China, and the surrounding Asian area. It has opened the door to creative scholarship in combined areas such as science, technology and society, and the emerging field of globalization.

One of the major goals of Professor Hsi-Sheng CH'I, the first head of the Social Science Division and Dean of Humanities and Social Science from 1993 to 1996, was to put Hong Kong studies on the international research map. "Hong Kong has never lacked people or scholars who addressed Hong Kong issues in the public forum but those concerns never really caught the attention of international scholars. We felt that our School could provide in-depth, serious scholarly analyses of Hong Kong studies and introduce them to the world stage."

The South China Research Center was set up in 1997, and has since started an oral history archive and undertaken a survey of historical buildings for Hong Kong's Antiquities and Monuments Office. The Center for Cultural Studies, started in 1998, tackles the question of identity and examines the experiences of ordinary people, not just elites.

The Survey Research Center is accumulating a database of material which will provide future researchers with the means to compare past and present trends. "Before, Hong Kong didn't have a survey center that could concentrate on a subject for 50 years," says Professor Pang-Hsin TING, Dean of Humanities and Social Science. "With the Center, scholars will be able to come back and trace what has been happening down the years in Hong Kong."

Prof Pang-Hsin Ting

(From left) Dr Steven Poon, Dr Alice Lam and Dr S Y Chung have been ardent supporters of HKUST since its earliest days.

Going Forward Together

Support for HKUST's research started even before the University officially opened. In 1990, the (Royal) Hong Kong Jockey Club added to its massive donation towards construction costs by announcing a HK$130 million seed grant to establish the Biotechnology Research Institute — the first of the University's interdisciplinary institutes. The second, the Hongkong Telecom Institute of Information Technology, was established with a grant from Hongkong Telecom Foundation (now Pacific Century CyberWorks Foundation).

By 1993, HKUST's inaugural fund-raising campaign, chaired by University Council member Dr Alice LAM, had raised over HK$90 million enabling HKUST to create a number of enterprising research facilities and funds to support education and research development. Among the research facilities were the Joyce M Kuok Laser and Photonics Laboratory, the Zheng Ge Ru Thin Film Science Laboratory, the Sino Software Research Institute, and the William Mong Solid State Clusters Laboratory.

Council, Court, and Senate members have continued to actively spread the word about the University's work, with both the founding Council Chairman, Dr S Y CHUNG, and current Council Chairman, Dr Vincent H S LO, vigorously involved in fund-raising.

Their words have been heeded, with many corporations and foundations assisting HKUST in its quest to push forward the high-tech environment in

(From left) Prof Pang-Hsin Ting and Dr Helmut Sohmen at the Inauguration Ceremony and Lecture of the Y K Pao Visiting Chair in Cultural Studies.

Major donors and President Woo at the opening ceremony of the Annex in 1999.

A clasp of gratitude: Dr S Y Chung (left) and President Woo (right) receive a donation from Dr Vincent Lo, Chairman of Shui On Group.

Hong Kong and beyond. Donations ranging from a few thousand to many millions of Hong Kong dollars have helped establish scholarship funds, purchase equipment, and construct additional buildings. Some companies have given in kind.

Individual contributors also play an essential part, often providing support in the form of advice and input, in addition to donations. In 1993, Court member Dr Helmut SOHMEN conceived, and has since sponsored, the Business Roundtable Dinner series, where University professors meet up with local CEOs and diplomats. Dr Sohmen also established the University's first endowed chair, the Y K Pao Visiting Chair in Cultural Studies, in 1999.

With limited funding from government sources, many projects and programs would remain unrealizable without private support. One recent undertaking was the building of the University's six-storey Annex, which opened in 1999, providing much-needed space for the rapidly growing programs in executive education, applied R&D, technology transfer, and international collaboration. Donations for the project totaled HK$95 million.

Onwards and Upwards

"The University has achieved a lot in 10 years and has already made an impact on the Hong Kong society," says Professor Otto Lin. "We are not the largest or the best in everything, but we have brought the culture of innovation and technology to Hong Kong."

The challenge ahead will be to sustain the advance. It will take people, young people with bold ideas, creative thoughts, and a fascination for knowledge. On the HKUST campus, the creators of the future are already hard at work.