Chief Executive's
Commission on Innovation and Technology

First Report

September 1998

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Introduction

In his October 1997 Policy Address, the Chief Executive set forth a vision of making Hong Kong an innovation centre for the region. In March 1998, he appointed this Commission to advise him on the measures necessary to fulfil this new vision. This First Report sets out the Commission's recommendations made in the six months of its establishment.

Economic Background

2. The Hong Kong economy has been undergoing a significant transformation characterised by the territory's increasing links with the Mainland of China and the region, and a structural shift within the manufacturing sector from production to manufacturing-related services.

3. The relocation of low value-added and labour-intensive production to the Pearl River Delta and elsewhere has enabled our firms to expand their operations substantially. It has also released scarce resources (manpower and land) for upstream, higher value-added activities in Hong Kong. This is both necessary and appropriate for Hong Kong to sustain its growth and prosperity.

4. Hong Kong faces a number of major challenges. There is strong competition from neighbouring economies for Hong Kong's regional roles in trade, finance, transportation and communications. With respect to manufacturing, Hong Kong must strive to retain, support and further develop high value-added activities. Hong Kong is also facing stiff competition from other low-cost economies in the low-end product category. A fundamental challenge is how Hong Kong should position itself in the knowledge-based global economy of the 21st century.

A New Vision : Hong Kong as Centre of Innovation and Technology

5. The vision of making Hong Kong a centre of innovation and technology is a timely response to these challenges. We envisage Hong Kong to be an innovation-led, technology-intensive economy in the 21st century, serving the region not only as a business and financial centre, but also as -

- a leading city in the world for the development and use of information technology;
- a world-class design and fashion centre;
- a regional centre for multimedia-based information and entertainment services;
- a world centre for the development of health food and pharmaceuticals based on Chinese medicine;
- a leading supplier in the world of high value-added components and products where Hong Kong already excels today;
- a regional centre for supplying professional and technological talents and services; and
- the marketplace for technology transfer between the Mainland and the rest of the world.

6. Innovation and technology increase the competitiveness of firms by introducing more efficient ways to perform existing activities or creating greater buyer value. They are important to all sectors of the economy, including traditional or 'low-tech' manufacturing and service industries. They may be applicable to every aspect of the value-adding chain.

7. Acquiring technology is as important as developing technology. The science and technology base of Hong Kong should be

strengthened. The Government should adapt its education and manpower policies to address employment issues brought about by innovation and technological change.

8. The Report has identified some broad technology areas relevant to Hong Kong. Among them, information and communication technologies are particularly important.

Realising the Vision

9. Realising the vision would be a long-term process and a major challenge for Hong Kong. While industry must make its own choices and investments, the Government should play the role of a promoter, facilitator and supporter.

10. The Government should commit to a focused and coherent strategy. We recommend the following framework -

- Strengthen technological infrastructure and promote technological entrepreneurship.
- Build up human capital meeting the needs of a fast-changing, knowledge-based economy.
- Enhance technological collaboration with the Mainland.
- Foster university-industry partnership.
- Lower information, financing and regulatory barriers.

Innovation and Technology Fund

11. To underline the Government's commitment and provide a secure source of funding for implementing this strategy framework, we recommend the establishment of an Innovation and Technology Fund with an initial injection of $5 billion to meet requirements in the short to medium term.

Applied Science and Technology Research Institute

12. Hong Kong has no technological infrastructure in respect of midstream R&D. This has created serious difficulty for industry to commercialise innovative ideas or scientific research results. To address this, we recommend that a publicly-funded applied science and technology research institute of an adequate size be set up as soon as possible.

Enhancing Technological Collaboration with the Mainland

13. We recommend the establishment of a comprehensive database of Mainland technological resources, focusing initially on sectors especially relevant to Hong Kong. Industrial and professional organisations should be encouraged to organise more promotion and networking activities, with Government financial support where appropriate.

14. We recommend that relevant industrial support bodies in Hong Kong seek to establish a collective mechanism for liaison with relevant bodies in the Mainland, at both the central government and regional levels.

15. We recommend that Hong Kong should co-operate with the Mainland in the area of technological support infrastructure. This may include joint R&D, assisting Hong Kong firms in the Pearl River Delta area to upgrade their technologies, partnership between the future Hong Kong Science Park and its Mainland counterparts, and technological exchanges between universities. Easing cross-border travel of research scientists and engineers is important.

Fostering University-Industry Collaboration

16. To help industry to leverage university research resources, we recommend that the universities be encouraged to set up a task force to co-ordinate publicity on research and a central database of their research resources, to establish a system of industrial sabbatical, and to allow staff to take no-pay leave for technology-transfer or entrepreneurial work. A forum should also be set up bringing together industrialists and university researchers to identify commercially relevant research topics. We further recommend the introduction of a package of incentive schemes to promote university-industry partnership in R&D.

17. We recommend that the University Grants Committee consider building an element into its funding methodology to reflect the level of university-industry interaction in research. The universities should be encouraged to promulgate a clear promotion policy recognising researchers' efforts in commercially relevant work.

Issues for Study in the Next Phase

18. In the next phase, we shall examine outstanding issues in the following areas -

- Building up manpower for technology development.
- Attracting technological talents to Hong Kong.
- Fostering a culture of innovation and technology in industry.
- Maintaining a conducive business environment.
- Reviewing institutional arrangements.

19. We plan to complete our work by June 1999.

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The Main Report

CHAPTER ONE

INTRODUCTION

(This chapter gives a brief account of the background to the setting up of the Commission and how the Commission has proceeded with its work in the six months of its establishment.)

1.1 In his October 1997 Policy Address, the Chief Executive announced that Hong Kong must set new courses for development as the world economy had entered a new era of increasing competition. He declared that one of the courses was for Hong Kong to develop high value-added industries and services. Recognising that innovation, utilisation of new technologies and developing new economic activities were important for sustaining Hong Kong's economic growth and high standard of living, he set forth a new vision of making Hong Kong an innovation centre for South China and the region.

Appointment of the Commission

1.2 In March 1998, the Chief Executive appointed this Commission to advise him on the measures necessary to fulfil this new vision. Our specific mission is to identify the steps that Hong Kong should take, and the institutional arrangements that should be put in place, to drive forward innovation and technology upgrading in the Hong Kong economy, so as to add value to its commercial and industrial activities and to its economic hinterland. The Commission's terms of reference and membership are at Annexes A and B of this report.

The Community Debate

1.3 We are keenly aware that the community has a deep interest in the issues facing the Commission. Hong Kong's transformation into a predominantly service-oriented economy over the past two decades has sparked an ongoing debate in the community about the future course of Hong Kong's economic development. A key issue is whether Hong Kong should broaden and upgrade its economic base in order to achieve sustainable economic growth into the next century, provide the employment opportunities needed and maintain a high standard of living for its people.

1.4 There is a body of opinion that Hong Kong should move to develop a 'high-tech' manufacturing industry as the engine for future economic growth. On the other hand, some people have cast doubt on whether Hong Kong has the capability or resources to develop a high-tech manufacturing industry. Some others have queried whether such a deliberate move would be necessary in the first place, pointing out that the focal point should be increasing the productivity of industry[1]. Some have contended that Hong Kong should upgrade its industry towards higher value-added activities, rather than focusing narrowly on developing a high-tech manufacturing industry. Furthermore, there have been plenty of discussions about the appropriate roles of the Government and the private sector in bringing about these changes. The current economic adjustment in Hong Kong triggered by the regional financial turmoil has brought the debate into a sharp focus and with immediate urgency.

1.5 In this report, we attempt to address the issues outlined above and to make recommendations on the way forward. We must stress that our recommendations are aimed at setting Hong Kong on a course for achieving longer term economic stability and growth. They are not a panacea for Hong Kong's immediate difficulties.

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[1] In this report, the term 'industry' refers to both manufacturing and service industries, unless the context suggests otherwise.

The Commission's First Phase of Work

1.6 The Commission was requested by the Government to complete its work within twelve to eighteen months, and to submit an interim report to the Chief Executive before the end of September 1998. Accordingly, we decided to pursue our task in two phases. In the first phase, we have broadly reviewed most of the issues relevant to our task. But due to time constraint and the need to give each issue in-depth consideration, we have focused our study on some issues only. Our priorities in the first phase are -

(a) an overall review of Hong Kong's technological infrastructure;

(b) measures to facilitate industry to tap the technological resources in the Mainland of China (the Mainland); and

(c) measures to strengthen collaboration between the local academia and industry.

For other issues relevant to the Commission's remit, we have taken stock of their current situation with a view to setting the general direction for our work in the second phase.

1.7 In the six months between March and September, the Commission held seven formal meetings. In addition, groups of Commission members held many informal discussions on specific areas.

1.8 Throughout our deliberations, we have been mindful of the importance of making recommendations which will suit the needs of Hong Kong and which will take account of its special strengths and characteristics, instead of merely copying the experience of other economies.

1.9 Making Hong Kong an innovation centre will be a major undertaking for its people. It will be necessary to mobilise a

concerted effort from all parties involved and to generate a momentum for change. With this in mind, we organised a series of activities to reach out to the stakeholders as well as the community at large. In April, we invited over 300 trade and industrial organisations and other interested parties to give their views on a consultative document setting out the issues facing the Commission. This document and a list of the organisations and individuals who have responded are at Annex C.

1.10 During May to August, the Commission held three workshops and one luncheon talk with the aim of promoting public awareness and debate about the new vision of Hong Kong. In addition, we visited a number of local manufacturing and service firms as well as some technology support bodies and institutes. Recognising the growing inter-dependence between the Pearl River Delta and Hong Kong economies, we organised a field trip to the Pearl River Delta area in September, visiting some factories and exchanging views with senior Guangdong government officials. Additional information about these activities is at Annex D.

1.11 The chapters that follow set out the outcome of our deliberations in the first phase of our work.

CHAPTER TWO

ECONOMIC BACKGROUND

(This chapter outlines the economic context within which the Commission's deliberations have been made, focusing on Hong Kong's key characteristics and highlighting the challenges it faces.)

2.1 Before the onset of the regional financial turmoil, Hong Kong had enjoyed robust economic growth for over 40 years, punctuated only by short-term adjustments to mainly external events. Valued at $205,900 (US$26,400) in 1997, Hong Kong's per capita Gross Domestic Product (GDP) has surpassed that of the United Kingdom, Canada and Australia. According to the World Bank, in 1995 Hong Kong's per capita Gross National Product was the fifth highest in the world on a purchasing-power-parity basis, behind only Luxembourg, the United States, Switzerland and Kuwait.

2.2 During this period of rapid growth, Hong Kong has established a substantial manufacturing network in the region, become a major regional centre of trade, finance, transportation and communications, and consolidated its traditional position as the main entrepot between the Mainland and the rest of the world.

2.3 These achievements can be attributed largely to the following comparative advantages of Hong Kong -

- Geography (Hong Kong has one of the best natural harbours in the world, is located at the centre of East Asia within a few hours' flight to all the major cities in the region, and is a gateway to an emerging huge market in the Mainland).

- Rich entrepreneurial culture.
- Productive and adaptable workforce.
- Resourceful economic hinterland that provides land and manpower resources at relatively low cost.
- Free market economy in which local and foreign participants alike can compete on a level playing field.
- Well-established and sound legal system.
- Excellent transport, financial and telecommunications infrastructure.
- Small, clean and efficient government.
- Simple taxation system with low rates.

Hong Kong's Economic Transformation

2.4 Since 1978, when the Mainland began implementation of its open-door policy and economic reforms, the Hong Kong economy has been undergoing a significant transformation. The contribution of the manufacturing sector to GDP has dropped substantially, with a corresponding increase in the service sector's contribution (see Table 2-1). The increasing orientation of the Hong Kong economy towards services is also evident in employment. Table 2-2 shows the share of the service sector in total employment vis-à-vis that of the manufacturing sector.

Table 2-1
Percentage Contribution of Different Sectors to GDP

	Percentage contribution	
	1980	**1996**
Primary production (agriculture, fisheries, mining and quarrying)	1	0.2
Secondary production, of which	32	15
Manufacturing	*24*	*7*
Construction	*7*	*6*
Supply of gas, electricity and water	*1*	*2*
Tertiary production (services)	67	84

Source of data : Census and Statistics Department
Figures may not add up to 100% due to rounding

Table 2-2
Percentage Share of Service and Manufacturing Sectors in Total Employment

	Percentage share	
	1980	**1996**
Services	48	79
Manufacturing	42	11
Others	10	10

Source of data : Census and Statistics Department

2.5 Hong Kong's economic transformation is characterised by the territory's increasing links with the Mainland and the region, and a structural shift within the manufacturing sector from production to manufacturing-related services.

Links with the Mainland and the Region

2.6 The past decade saw the re-emergence of Hong Kong as a major entrepot serving the region in general and the Mainland in particular. At present, nearly 90% of Hong Kong's re-exports involve the Mainland either as a source or as a destination. Trade in services has also expanded rapidly, as Hong Kong consolidates its role as a provider of services to the region, including financial, business, and technical support. Furthermore, Hong Kong firms invest heavily in the region, particularly in production capacity and in property, hotel and infrastructural development.

Manufacturing Support Services

2.7 The reducing share of the manufacturing sector in GDP and employment is mainly the result of Hong Kong manufacturers diversifying their production operations into the Mainland and other Asian economies with cheaper land and labour. These firms tend to retain many of the other high value-added activities in the manufacturing process - such as headquarters operation, trade finance, product development, marketing and sales, and international procurement - in Hong Kong. However, these activities are no longer classified as 'manufacturing' under Hong Kong's statistical classification system[2].

2.8 By moving their production processes to the Mainland and elsewhere, Hong Kong-based firms have overcome the two critical resource constraints - land and labour - in Hong Kong and have grown far beyond the size that would have been possible had their activities been confined to Hong Kong. It is estimated that Hong Kong-based manufacturing firms employ more than five million workers in Guangdong alone, as compared to a peak of 900 000 manufacturing employees in Hong Kong in 1981. The substantially enlarged production base of Hong Kong manufacturers has in turn expanded the demand for manufacturing support services in Hong Kong by at least the

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[2] Hong Kong adopts a classification system developed and used by the United Nations.

same extent, and these activities generally operate over a much wider geographical span than before.

2.9 Thus, contrary to popular belief, manufacturing and manufacturing-related services remain an important pillar of the Hong Kong economy. Indeed, manufacturing is far more important to Hong Kong than the statistics in Tables 2-1 and 2-2 may suggest.

Regional Economy – Co-operation with Pearl River Delta

2.10 The economy of Hong Kong is increasingly interrelated with that of South China, particularly the Pearl River Delta area. It is estimated that in the Pearl River Delta area alone there are some 70 000 factories that are either fully or partially owned by Hong Kong-based firms, or are engaged in outward processing for Hong Kong. The relocation of labour-intensive processes with lower added value to the Pearl River Delta area has enabled the release of scarce resources (both labour and land) for upstream, higher value-added activities in Hong Kong. We consider this both necessary and appropriate for Hong Kong to sustain its prosperity and a high standard of living for its people.

2.11 Hong Kong's global business network, management savvy and abundant supply of capital and the Pearl River Delta area's land, labour and other resources have created good synergy. We believe that the future direction is for Hong Kong to continue to capitalise on this by strengthening its economic ties and co-operation with the Pearl River Delta area. Such co-operation will benefit both places.

Challenges faced by Hong Kong

2.12 But challenges abound :

(a) Competition for Hong Kong's existing regional roles

Hong Kong is facing strong competition from neighbouring economies or cities to take its place as the regional centre for trade, finance, transportation and communications. Many of these economies are catching up fast on Hong Kong's traditional strengths, by investing heavily in physical infrastructure and by liberalising and deregulating their economy. For example, Singapore is rapidly developing as a regional financial and business service centre. Taiwan has set a goal of becoming a centre of business and transportation for the Asia-Pacific. Shanghai is poised to become a major entrepot and financial centre.

(b) Retaining high value-added manufacturing-related activities in Hong Kong

With respect to manufacturing, we consider the shift of emphasis from production to other higher value-added aspects of the manufacturing process entirely appropriate for Hong Kong's high-cost and high-density environment. The challenge is to retain, support and further develop these high value-added activities in Hong Kong. This is essential because, again, other economies in the region have the capability to catch up fast. For example, an increasing amount of the technical support needed by production facilities in the Pearl River Delta area can be sourced locally, at lower cost than is available from Hong Kong. Singapore and Taiwan have indeed overtaken Hong Kong in terms of technology in many areas. Apart from this, with the dispersal of manufacturing, the support

services become increasingly more complex, requiring more sophisticated management and technical inputs.

(c) Stiff competition from low-cost economies

Even though Hong Kong manufacturers (including their operations in the Mainland) are still able to offer very good quality products cost-effectively in the low-end product category, they are facing stiff competition from other low-cost economies both within and outside the region. The increasingly integrated global economy means keener competition from places far and near and that orders will shift very quickly to the most competitive place. In addition, Hong Kong's competitiveness is being eroded by the emergence of regional trade pacts under which participating economies give preferential market access to products manufactured in other parties to the pact. These arrangements are in place in many of the major export markets of Hong Kong - North America, Europe and South East Asia. Hong Kong is not a party to any such arrangements.

(d) Positioning Hong Kong in the knowledge-based global economy of the 21st century

The increasing competition for Hong Kong's current activities, the rapid modernisation of the Mainland economy, and the ongoing economic transformation in Hong Kong raise questions about its future role. As Hong Kong develops into a relatively mature economy with a general standard of living comparable with that of many advanced economies in the world, Hong Kong must set itself on a course which will ensure longer term stability and growth of the economy. The 21st century is predicted as one in which global economic competition will be predominantly based on knowledge and innovations. How Hong Kong should position itself in the knowledge-based

global economy of the future is a fundamental challenge for the territory.

2.13 Hong Kong must respond to these challenges. Continuing to strengthen and capitalise on its existing competitive advantages is essential. But this alone is not sufficient. Hong Kong must broaden and upgrade its economic base by creating new and more effective niches through innovation and technology.

CHAPTER THREE

A NEW VISION : HONG KONG AS CENTRE OF INNOVATION AND TECHNOLOGY

(This chapter elaborates on the new vision, examines a number of conceptual issues related to innovation and technology in the context of Hong Kong, and identifies some technology opportunities.)

The Vision

3.1 Innovation and technology are vital to the future prosperity of Hong Kong. They will strengthen Hong Kong's current regional roles and spur new high value-added industries, providing stability and growth for the economy in the longer term. They will play an essential role in increasing the added value, productivity and competitiveness of Hong Kong industries in the knowledge-based global economy of the 21st century.

3.2 The vision of making Hong Kong an innovation centre for the region is a timely response to the challenges outlined in Chapter Two. Under this vision, Hong Kong would be an innovation-led, technology-intensive economy in the 21st century, serving the region not only as a business and financial centre, but also as a centre for the development and commercialisation of innovative ideas and technology. In particular, we envisage Hong Kong to be -

- a leading city in the world for the development and use of information technology, especially in electronic commerce and software engineering;

- a world-class design and fashion centre;

- a regional centre for multimedia-based information and entertainment services;

- a world centre for the development of health food and pharmaceuticals based on Chinese medicine;

- a leading supplier in the world of high value-added products and components where Hong Kong already excels today;

- a regional centre for supplying professional and technological talents and services; and

- the marketplace for technology transfer between the Mainland and the rest of the world.

3.3 We examine in the following sections the key elements and concepts making up this vision.

Basic Concept

3.4 Innovation and technology are important drivers of the long-term growth of an economy. Innovation increases the competitiveness of firms by introducing more efficient ways of performing existing activities (cost reduction) or creating greater buyer value (product differentiation). Innovation is defined broadly to include both improved technology and better methods of doing things. Innovation may be manifested in new products or services; improved quality; new ways of production, packaging, marketing or distribution; new markets; new supply sources; new organisations or systems; and so on.

3.5 Technology improvement is a powerful force for innovation. The experiences of advanced economies such as the United States and Japan, and those of newly industrialised economies like Israel, Singapore and Taiwan show that technology is an important factor underpinning the creation of competitive advantages and a robust

economy. It is estimated that technology and advances in knowledge account for 80% of the growth in total factor productivity in the United States today[3]. The current United States Administration has identified technology as the engine of economic growth. The Chinese leadership refers to technology as the 'number-one' factor of production.

3.6 We should emphasise that improved technology is important not only to the ‘ high-tech’ segments of the economy, such as high-tech product manufacturing, but to all sectors of the economy, including traditional or relatively ‘ low-tech’ manufacturing industries, as well as service industries. Furthermore, improved technology may be applicable to every aspect of the value-adding chain, including for example the way a product or service is designed, produced, marketed or delivered.

3.7 Although the technological factor is a key element in innovation, it is by no means the only one. The non-technological aspects of innovation are gaining increasing recognition as being equally important to maintaining the competitive advantage of firms and economies. These aspects include, for example, the ability to identify and anticipate market trends, and the willingness and ability to introduce changes in management, work organisation, supply and distribution, and skills of the workforce.

High and New Technologies

3.8 During our deliberations, we have come across a view that Hong Kong should not devote any substantial effort to high or new technology because this will be incompatible with its competitive strengths. This view appears to stem in a large part from the misconception of equating high or new technology automatically with certain state-of-the-art high-tech product manufacturing industries such as aerospace, high-end computers or pharmaceuticals. In fact, high or new technology is a generic term referring to technology with high or

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[3] 'Technology in the National Interest', Department of Commerce, United States Government, 1996.

new science content that creates or rejuvenates products, services, processes or systems. We believe that Hong Kong industry can benefit greatly from the adaptation of *appropriate* high or new technologies in its bid to compete in the global marketplace.

Box 3-1

The Success Story of a Technology-based Enterprise

Varitronix Ltd. was established in 1978 by a group of academics from Hong Kong's universities with an initial investment of $1.5 million. It has since grown to be one of the world's leading manufacturers of liquid crystal display (LCD), with a strong capability in custom design and manufacture of LCD-related products. Varitronix was publicly listed in 1991 and currently has a total market capitalisation of over $4 billion. From the outset, Varitronix has adopted an R&D-driven strategy, focusing on custom design instead of competing on price with large foreign manufacturers of standard LCD units. To add value to products and drive further growth of the company, Varitronix has diversified into designing and making end products that incorporate its own LCDs. A notable example is the Customer Input Terminal for off-course betting that Varitronix makes for the Hong Kong Jockey Club. Varitronix's competitive strength mainly lies in its technological capability as well as ability to leverage on the synergy between Hong Kong and the Mainland – technology-intensive product development and front-end production in Hong Kong; and labour-intensive back-end production in the Mainland.

Box 3-2

The World's First Interactive TV Service

Hongkong Telecom IMS launched the world's first commercial interactive television service in Hong Kong in 1998. This service is delivered to customers via the telephone line using state-of-the-art data compression technology and Hong Kong's fully digital fibre-optic broadband network, which has been another 'world first'. Interactive TV offers a range of multimedia-based entertainment and information services including video-on-demand, home banking, home shopping, network games and interactive education. With a declared commitment to invest $10 billion in technology and equipment, the company capitalises on Hong Kong's strengths in the entertainment, telecommunications, information technology, and multimedia production industries.

Manufacturing vs Service Sectors

3.9 We suggest that equal attention be paid to promoting innovation and technology in both the manufacturing and service sectors. Over 80% of Hong Kong's GDP comes from the service sector. Hong Kong's economic growth can therefore be bolstered significantly by increases in productivity derived from innovation and application of technology in its service industries. There is a growing trend towards specialisation in the handling of production, marketing, delivery and service of manufactured goods on a global scale, and the distinction between manufacturing and service has become blurred. In Chapter Two, we have noted the structural shift within the manufacturing sector from production to manufacturing-related services within Hong Kong's geographical boundary. Hong Kong has emerged as a control, support and co-ordinating centre for production operations in the region. The further development of these 'manufacturing' activities would require investments in higher skills and advanced technologies. This applies not only to R&D, but also to many other activities such as supply-chain and financial management.

Box 3-3
Innovation and Technology Application in the Garment Industry

TAL Apparel Ltd. is a leading garment manufacturer headquartered in Hong Kong, with production facilities spread across the region and an annual turnover of $4.3 billion. One in eight dress-shirts sold in the United States is made by this company. TAL pays great attention to innovation and technology to improve products, streamline logistics and cut down on inventory cost for itself and its customers. Its R&D efforts have resulted in patented wrinkle-free and pucker-free seam technologies widely accepted by the market. It has also invested heavily in developing an in-house proprietary information system. By using advanced supply-chain management techniques, TAL is able to cut down the lead time for placing orders by the customer from six months to as little as four weeks, and to deliver products directly to retail outlets of overseas customers. These measures can reduce substantially the inventory cost of the customer. New technologies and sophisticated customer services enabled by information technology help TAL to remain competitive and profitable.

Traditional vs New Industries

3.10 From the submissions we have received and the views expressed in the workshops the Commission has organised, we have noted a concern held in some quarters that the emphasis on innovation and technology would mean that traditional 'low-tech' industries would have no role to play in the future economy of Hong Kong. This is obviously a misconception. Traditional and low-tech manufacturing industries, such as textile and garment, toy, plastics and metal industries, can increase their added value and productivity through innovation and application of technology. We suggest that the Government should encourage the traditional industries of Hong Kong to engage in product and process innovation, as well as help them to upgrade their technology level. Particular attention should be paid to promoting original product design, which can be a powerful tool to add value to products in traditional industries.

Box 3-4
High Technology to Improve Quality and Efficiency

Photographic Industry

Sunpet Industries Ltd. is one of the largest camera manufacturers in Hong Kong, producing about 50 000 cameras and binoculars per day. In the manufacture of moulds for plastic lens, it used to adopt the traditional manual lapping method which limited the company to producing spherical lens. Spherical aberration had been a problem. In 1995, Sunpet adopted ultra-precision diamond turning technology to make aspheric plastic lens which could reduce spherical aberration and hence improve the photographic image quality of the camera. The time required for fabricating moulds could also be shortened by 30% as compared to the conventional lapping process. Since the adoption of this technology, Sunpet's production volume has increased substantially.

Watch Industry

Crownberg Industries Ltd. adopted in 1997 a laser marking technology developed by the Hong Kong Productivity Council for marking patterns on the watch case or dial face. Laser marking is much more flexible than traditional metal stamping or chemical etching methods, allowing greater variation in watch design. It also improves the quality of marking particularly on curvy surface and shortens manufacturing lead time by 50%. This technology is particularly advantageous for jobs with batch size below 5 000 pieces. As a result of using the technology, Crownberg has been able to move into the mid-range market, attracting orders from brand name watch companies and improving business by 30%.

3.11 However, it will not be sufficient to focus just on upgrading our traditional industries. As the experience of Hong Kong's economic development has shown, creating new industries in response to changes in market demand and competitive advantage will be important for Hong Kong to sustain its economic growth.

Technology Development and Acquisition

3.12 It is as important for our firms to acquire technology from outside sources as to develop technology in-house. Indeed, research suggests that many industries, particularly those in the service sector, achieve productivity growth mainly by acquiring technology through purchasing and assimilating advanced machinery or equipment, or adopting intermediate high-tech goods. The concept of technology acquisition involves not only the introduction of new machinery on the shop floor or into the office, or the adoption of new intermediate goods. It also involves vital steps taken by firms to adapt the acquired technology to their needs. These steps may include reorganisation of work or material flow (such as just-in-time production programming) and improved management practices on the factory floor, in production development, and in marketing. The adaptation in itself is an incremental act of innovation.

3.13 We believe that the Government should, apart from encouraging the development of high or new technologies, pursue policies and initiatives to foster and support technology acquisition and adaptation by our firms. Regardless of whether technology is to be developed or acquired, Hong Kong firms should invest in increasing their technological awareness and capability. This will enable them to better understand and manage technology as well as to interact, improve and innovate. At a broader level, the science and technology base of Hong Kong should be strengthened to provide a solid foundation for exploitation of the technological opportunities before it.

Implications for Employment

3.14 Innovation and technological change have been described by some people as a process of 'creative destruction'. They create jobs which are often in new industries and require new skills, while eliminating existing jobs, companies and in some cases even entire industries. They may also demand new skills in existing jobs. Historical evidence[4] shows that on the whole, this process has led to a net increase in employment, as new industries replace old ones and workers adapt their skills to changing demand. It also results in better paying jobs and improved quality of work.

3.15 In promoting innovation and technology upgrading in the economy, the Government needs to adapt its education and manpower policies to address the challenges arising out of this rapid job creation and destruction process. In particular, it will be necessary to -

- improve the matching of manpower supply and demand in terms of skill requirements;

- strengthen services to help ease the transition from one job to another and increase employees' skills to prevent job losses; and

- strengthen retraining programmes for workers who are displaced.

Moreover, the Government needs to communicate to the community the wider economic benefits of innovation and technological change to the society, in order to carry the community along in the pursuit of the new vision.

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[4] 'Technology, Productivity and Job Creation', OECD Jobs Strategy Report, 1996.

Technology Opportunities

3.16 We suggest in this section some broad technology areas which are especially relevant to Hong Kong, and the development and application of which will help add value to and increase the competitiveness of relevant industries. These technology areas are not prescriptive or exhaustive. They illustrate the technology opportunities available due to Hong Kong's characteristics. The pursuit of these and other emerging opportunities will help to realise Hong Kong's vision of becoming a centre of innovation and technology in the 21st century.

3.17 These technology opportunities fall into four main categories -

(a) areas where improved technology will help Hong Kong maintain and develop its existing roles as a regional centre of trade, finance, transportation and communications, and as a base for providing technical input (e.g. product and process design and development) and business support (e.g. international procurement and finance) for production operations in the Mainland and elsewhere. Examples are information and communications technologies, electronics, advanced manufacturing technologies, product design, packaging design and supply-chain management;

(b) areas where Hong Kong's position relative to the Mainland offers distinct competitive advantages, for example, the development of health food and pharmaceuticals based on Chinese medicine, Chinese language-based software, and technology to increase agricultural productivity;

(c) areas where there are significant opportunities for Hong Kong to exploit emerging or new technologies which either match Hong Kong's strengths or will create synergy with existing industrial clusters in the Hong Kong economy. These include, for example, multimedia technology for the

information and entertainment industries, and materials technology for textile and garment, plastics, metal and construction industries; and

(d) areas in which Hong Kong already has considerable expertise in the application of high or new technology, or where it may develop technical competence to solve its problems and exploit this competence by selling services and products to the region. These include, for example, civil engineering (e.g. bridges and tunnels), telecommunications, and environmental technology (e.g. coastal and atmospheric research).

3.18 We wish to highlight the strategic importance of and opportunities offered by information and communication technologies. They are important not only as high-growth and fast-developing industries per se, but are also key enabling technologies for adding value to other industries. The development of electronic commerce, in particular, will revolutionise the way business is transacted, creating whole new industries for information and knowledge-based intangible products. Being an international business, financial and communication centre, Hong Kong already has a great demand for the most sophisticated or advanced applications of information and communication technologies. These technologies complement Hong Kong's highly competitive telecommunications, information and entertainment industries. Moreover, Hong Kong will benefit from the considerable technological resources in the Mainland in the development of information technology, e.g. in software development.

CHAPTER FOUR

REALISING THE VISION

(This chapter reviews Hong Kong's current situation in respect of innovation and technology, discusses the role of the Government in their promotion, and proposes a policy and strategy framework for realising the vision.)

4.1 To turn Hong Kong into a centre of innovation and technology would be a relatively long-term process, demanding sustained and concerted efforts from industry, the academia, the Government and the community at large. In this and the following chapters, we set out our views on how this vision can be realised. As a first step, we look at the overall framework.

Current Situation

4.2 Hong Kong has good fundamentals in terms of its physical infrastructure, open and free market policies, and a sound legal system including a good regime for protection of intellectual property rights. In recent years, the Government has increased significantly its investments in technology. It has also taken steps to strengthen Hong Kong's technological infrastructure. For example, it has established the Industrial Technology Centre in 1993 and is developing the Hong Kong Science Park. It has introduced a variety of funding schemes to promote commercial technology development and to nurture the growth of technology-based enterprises. In our view, the Government's effort has been hampered by the absence, or the perceived absence, of a clear and strong policy commitment as well as a focused and co-ordinated strategy for supporting innovation and technology development, commercialisation and use.

4.3 Hong Kong firms are renowned for their entrepreneurial dynamism and their international character. They are relatively strong in management and process innovation, and are quite efficient in exploiting well-established technologies. On the other hand, with a few exceptions, Hong Kong firms are weak in the development and widespread application of new technologies, and most tend to adopt a short-term, cost-minimisation business strategy, avoiding investment in technologies which may require a longer timeframe to yield returns. Relatively few entrepreneurs choose to develop technology-intensive businesses.

4.4 Hong Kong has a productive and adaptable workforce. Hong Kong's investment in education, particularly the substantial expansion of tertiary education in the last decade, has provided a sizeable supply of science and engineering graduates annually. Nevertheless, many of these graduates choose to work in other fields that are perceived to offer better career opportunities, such as sales and marketing. There are shortages of quality research scientists and engineers in industry and of skills in the management and transfer of technology.

4.5 Hong Kong has a vibrant, well-developed capital market which is also the largest source of venture capital in Asia. However, these capital funds focus on mature companies seeking expansion or on ventures involving tangible assets (e.g. infrastructure development projects) rather than start-up or young companies seeking to commercialise innovative ideas or new technologies.

4.6 With the expansion of tertiary education and the substantial resources being put into university research, a robust research culture is emerging in our universities. But collaboration between the universities and industry still has much room for improvement.

4.7 The scientific and technological resources in the Mainland potentially are a major and important source of input, but at present they are not readily leveraged.

4.8 Among cities in East Asia, Hong Kong is used by the largest number of multinational companies as regional headquarters to control their operation in the region. Most of them perceive Hong Kong as a world business city, not as an appropriate base for technology development or for high value-added production. Very few of them operate any R&D facility in Hong Kong. This is because Hong Kong currently does not have the image of a city with good technology culture or resources.

4.9 Focus and cohesion in strategy are required to enable Hong Kong to build on its strengths and address its weaknesses. The Government has a critical role to play here.

Role of Government

4.10 We believe that only industry itself has the abilities and judgement to manage the complex process of innovation and conversion of technology into products and services and bringing them to market. Industry must make its own choices and investments.

4.11 Nevertheless, the Government has an instrumental role to play in enabling the efforts of industry. In our view, the Government should primarily play the role of a promoter, by signalling to industry and the community at large the relevance and importance of innovation and technology to Hong Kong. Furthermore, the Government should play the role of a facilitator and supporter, by

- making essential investments in the physical, human and technological infrastructure;
- creating a business environment conducive to innovation and technology development, commercialisation and use;
- providing policy encouragement and incentives;
- co-ordinating industrial and business efforts; and

- providing financial support where appropriate.

4.12 We take the view that these roles of the Government are consistent with its long-standing economic philosophy of providing maximum support to industry and minimum intervention in the market.

A Proposed Policy and Strategy Framework

4.13 We note from the submissions to us and feedback from different channels that there is a perception problem about the absence of a clear Government technology support policy and strategy. Piecemeal initiatives in the past and sometimes confused messages about Government's non-intervention policy have not helped to resolve this problem. We recommend that, as a first and important step, the Government should send a strong and clear message about its commitment, direction and broad strategy to drive forward innovation and technology upgrading in Hong Kong. This will enhance understanding by the people of Hong Kong and by potential foreign investors about Hong Kong's new vision. More importantly, it will rally the support of industry, academia as well as the community at large to the fulfilment of the vision. We recommend that the Government adopt the following statement of innovation and technology support policy :

> *Innovation and technology are powerful drivers of the long-term growth of the economy. They are essential for increasing the added value, productivity and competitiveness of our industries in the knowledge-based global economy. Our objectives are to enhance the capability of our firms to innovate, as well as to stimulate technology development, commercialisation and use in Hong Kong. We shall pay attention both to sustaining and expanding our existing economic activities and to spawning new activities that match our current and future strengths. Our vision is to make Hong Kong a centre of innovation and technology in the 21st century.*

4.14 It is also important for the Government to promulgate a targeted and co-ordinated strategy for the implementation of this policy. Having regard to the broad assessment in paragraphs 4.2 to 4.9, we recommend that the Government adopt the following innovation and technology support strategy :

Within the framework of free-market principles, the Government should provide maximum support for innovation and technology development in our industries. Specifically, the Government should -

- *strengthen technological infrastructure and promote technological entrepreneurship;*
- *build up human capital meeting the needs of a fast-changing, knowledge-based economy;*
- *enhance technological collaboration with the Mainland;*
- *foster university-industry partnership; and*
- *lower information, financing and regulatory barriers.*

4.15 In the following chapters, we set out our views and recommendations on the individual components of this strategy.

Evaluation of Programmes

4.16 We recommend that the Government should develop performance measures and evaluation mechanisms for its existing technology programmes and the new initiatives recommended by the Commission. It is important to evaluate programmes, particularly on quality, on a regular basis for the purpose of greater accountability, more informed resource allocation and priority-setting, and better programme management. Having regard to the current situation in

Hong Kong, it may be necessary for a heavier involvement by the Government initially in order to jumpstart the process of change. As the private sector gradually picks up its share, there should be a case for the Government to play a lesser role in the longer term. To institutionalise a programme evaluation system would be useful in this regard.

4.17 There is a dearth of statistical information related to innovation and technology in Hong Kong. In this respect, Hong Kong lags far behind the developed economies and even some of its neighbouring economies. For future policy development and programme evaluation purposes, we recommend that the Government develop and publish appropriate statistical indicators of the level of innovation and technological sophistication in the economy.

CHAPTER FIVE

INNOVATION AND TECHNOLOGY FUND

(This chapter proposes the establishment of a fund to finance existing and new programmes that are relevant to promoting innovation and technology upgrading in the economy.)

5.1 We have recommended in Chapter Four that the Government should promulgate a strong and clear policy and strategy for promoting innovation and technology. To underline the Government's commitment to those policy and strategy and provide a secure source of funding for their implementation, we recommend that the Government set up an Innovation and Technology Fund (ITF). To produce a significant impact and to meet funding requirements in the short to medium term, we recommend an initial injection of $5 billion into this Fund. We further recommend that the Government should put in place a mechanism for evaluating the effectiveness of the Fund.

5.2 The proposed ITF will essentially be used to finance ad hoc projects that contribute to innovation or technology upgrading in industry, to be undertaken by government or non-government entities. Such projects may include, for example -

- commercially relevant R&D activity;
- human resource development activity;
- activity to promote public awareness about innovation and technology;
- activity to enhance the technological infrastructure;

- activity to promote or facilitate university-industry collaboration or Hong Kong-Mainland collaboration;

- activity to promote or facilitate technology diffusion, sourcing or acquisition; and

- activity to promote technological entrepreneurship.

5.3 At present, the three main government funding schemes for ad hoc projects relevant to innovation or technology upgrading are -

(a) Industrial Support Fund (ISF)

The money available for use by the ISF is approved each year by the Legislative Council. Under this arrangement, the ISF must compete for resources annually in the Government's central resource allocation exercise and any provision not spent at the end of a financial year will lapse.

(b) Services Support Fund (SSF)

The SSF received a capital sum of $50 million upon its establishment in 1996. After this amount was fully committed, a further $50 million was injected into the SSF in late 1997.

(c) Applied Research Fund (ARF)

The ARF has a total working capital of $750 million, derived from three separate capital injections into it (or its predecessors).

Box 5-1

Industrial Support Fund, Services Support Fund and Applied Research Fund

Industrial Support Fund - Established in 1994, the ISF finances projects which are beneficial to the development of Hong Kong's manufacturing industry and technology in general. In practice, the great majority of funded projects are related to the latter. Projects are mostly undertaken by industry support agencies, tertiary institutions, or trade and industry associations. To date, the ISF has committed HK$1.2 billion to some 340 projects. These projects seek to introduce new technologies, enhance infrastructural support, or improve productivity in specific industries. The amount of money provided for the ISF in 1998-99 is $278 million.

Services Support Fund - In 1996, the Government established the SSF to finance projects beneficial to the development and competitiveness of Hong Kong's service industry. The SSF has committed $50 million to finance projects which will benefit, for example, the wholesale and retail, tourism and professional service sectors.

Applied Research Fund - The ARF provides venture capital for technological ventures or R&D activities that have good commercial potential undertaken by local firms, either on their own or with non-local partners, say, a Mainland research institution. The Industry Department is in the process of contracting out the management of the ARF to private venture capital firms which will be closer to the market and which can provide input to the business development of the venture.

5.4 We suggest that the ITF, if established, should replace the ISF and SSF as the funding source for projects contributing to innovation or technology upgrading in both the manufacturing and service sectors[5]. These will include new projects arising out of our recommendations in this report, as well as any possible new initiatives to be recommended by us in the next phase of our work. With stepped-up promotional efforts and increased awareness about innovation and technology, there is likely to be an increase in applications for funds under the existing programmes of the ISF, SSF and ARF. We consider a $5 billion initial injection into the ITF appropriate to meet these funding requirements in the short to medium term, on the understanding that both capital and income of the Fund can be used to finance projects.

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[5] Whether the ISF and SSF should be retained as funding sources for projects not related to innovation or technology should be examined further by the Government.

5.5 We consider it important for the Government to develop guidelines for the use of the ITF and measures to assess the effectiveness of the ITF and whether the programmes and projects to be funded by it meet their objectives.

CHAPTER SIX

APPLIED SCIENCE AND TECHNOLOGY RESEARCH INSTITUTE

(This chapter outlines Hong Kong's technological infrastructure, identifies a gap in midstream research and development capability, and proposes the setting up of an applied science and technology research institute.)

6.1 We have conducted an overall, stock-taking review of the technological infrastructure of Hong Kong and have identified a significant gap in midstream R&D capability. To remedy this deficiency, we recommend that the Government should establish an applied science and technology research institute as soon as possible. We set out details of our deliberation below.

Overview of Hong Kong's Technological Infrastructure

6.2 The technological infrastructure of Hong Kong supports innovation and technology development in three main aspects -

(a) research and development;

(b) technical advice and support to industry; and

(c) human resource development.

The role and functions of the key players in this technological infrastructure are outlined in paragraphs 6.3 – 6.17.

Technological Infrastructure : Government Sector

Trade and Industry Bureau / Industry Department

6.3 The Trade and Industry Bureau is responsible for overall government policies on industrial technology support and development. It is assisted by the Industry Department (Ind D) in policy implementation. In particular, the Ind D administers the Industrial Support Fund, Services Support Fund and Applied Research Fund (see Box 5-1 for details). It also runs a Standards and Calibration Laboratory that maintains reference standards of measurement for Hong Kong, and a range of calibration services that are not readily available in the private sector.

Education and Manpower Bureau / University Grants Committee / Research Grants Council

6.4 The Education and Manpower Bureau is responsible for overall government policies on education, employment and human resource development, including policies on tertiary education, academic research, technical education and industrial training. In the determination and application of Government's funding for university education and research, it is assisted by the University Grants Committee (UGC) and the Research Grants Council (RGC).

Other Government Bureaus

6.5 Some other Government bureaus are responsible for policies related to technology and manpower development in specific economic sectors. For example, the Information Technology and Broadcasting Bureau takes charge of information technology and telecommunications.

Technological Infrastructure : Publicly-funded Non-government Sector

Universities

6.6 Through educating students and performing research, the universities build and develop the science and technology base of our economy. In 1998-99, the eight UGC-funded institutions offered 53 000 degree places and 14 000 sub-degree places. The universities are also expanding their links with industry through conducting commercially relevant research and providing technology transfer and consultancy services. Some universities have set up specific research centres or consulting companies for such purposes. Where R&D are concerned, the universities focus mainly on basic research and upstream applied research[6].

Vocational Training Council

6.7 The Vocational Training Council (VTC) is the primary vehicle in Hong Kong for providing technical education and industrial training at the craft and technician levels. In 1996-97, the VTC provided technical training to 44 000 full-time and 66 000 part-time students[7]. It also administers the Government's New Technology Training Scheme which offers matching grants to firms for sending their employees to acquire skills in new technologies.

Hong Kong Productivity Council

6.8 The remit of the Hong Kong Productivity Council (HKPC) is to promote increased productivity and the use of more efficient methods in industry. It is currently the main technology support

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[6] Annex E sets out the definition of different types of R&D activity.

[7] Included in these figures are 30 000 trainees at training centres attending courses ranging from one day to 44 weeks, and 19 000 part-time trainees.

organisation in Hong Kong providing a wide range of services in consultancy, training, and technical support to clients through its 38 technology centres, laboratories and workshops. It also offers some capability in technology development and product design, development and prototyping.

6.9 The HKPC currently employs about 600 staff, and has an operating budget of $380 million. The Government finances about 45% of this budget. The remaining 55% is met by income from services provided to clients.

Box 6-1

New Technology for Jewellery Industry

The **Hong Kong Productivity Council** developed a patented 'three-dimensional gold electroforming system' for the manufacture of hollow gold products with complex shapes and fine details. This technology is widely adopted by the jewellery industry to produce light-weight, high value-added fine gold articles, e.g. Chinese zodiac animals and popular cartoon characters, efficiently and at affordable prices to consumers. A whole new niche market for the jewellery industry has been created with estimated total revenue of $1.2 billion a year. In some jewellery retail chains, electroformed gold products contribute to about 70% of the total business in gold decorative jewellery products.

Hong Kong Industrial Technology Centre Corporation

6.10 The Hong Kong Industrial Technology Centre Corporation (HKITCC) operates a business incubation programme that aims to nurture technology-based start-up firms by providing them with low-cost accommodation as well as some management, marketing, financial and technical assistance. It also runs a range of activities to foster high technology development in Hong Kong. These include, for example, seminars, exhibitions, maintaining databases of market and technology information, and an Innovation Loan Scheme for young high-tech companies.

6.11 The HKITCC has a staff of 33 and an annual budget of about $40 million. It operates on a self-financing basis, deriving its income mainly from leasing office space in the HKITCC building[8] at market rates to established technology-based firms.

Box 6-2
Technology Incubator Service : A Success Story

Cirkisys Technology Ltd. offers product design and system engineering consultancy services for the telecommunications industry in the Asia-Pacific. Its major business is in pager and paging network design. When it was admitted into the incubator programme of the **Industrial Technology Centre** in 1992, Cirkisys employed only six people with annual revenue of $400,000. It 'graduated' in 1994 after a locally listed company made an equity investment into it. It has since grown into a 300-people company with 80 engineers and annual revenue of over $200 million. In 1997, it developed a Radio Data System pager, one of the two pager products of its kind available in the world today.

Hong Kong Institute of Biotechnology

6.12 The mission of the Hong Kong Institute of Biotechnology (HKIB) is to provide the catalyst and essential infrastructure for the emergence of a successful biotechnology industry in Hong Kong, through the provision of downstream R&D support and an incubator facility for start-up biotechnology companies. The HKIB operates mainly on project-dependent funding from the ISF, as well as on private donation and income from clients.

[8] The Government gave the HKITCC a capital grant at the outset that included the cost of land and a building with lettable space to provide income to support its activities.

Box 6-3
Support for Pharmaceutical Industry

With a grant of $14 million from the ISF, the **Hong Kong Institute of Biotechnology** set up a Pharmaceutical Technology Centre in 1997 to help the pharmaceutical industry develop and upgrade production technologies. The current focus of the Centre is to assist manufacturers to upgrade their production systems to meet the GMP standard – a set of requirements widely adopted in the world for manufacturing pharmaceutical products, and which will become mandatory in Hong Kong in the year 2000. Only a few local firms can meet this standard at present.

Hong Kong Science Park

6.13 The mission of the future Hong Kong Science Park is to help position Hong Kong as a regional centre for innovation and R&D activities. It aims to achieve this by providing land and premises suited to the needs of high technology firms and activities, with a management which is actively engaged in the transfer of technology and business skills to the organisations on site. The intention is to create a focal point and a conducive environment for attracting overseas technology-based firms and activities to Hong Kong, and stimulating the growth of local technology-based businesses.

6.14 The Hong Kong Science Park will be located at a site of 22 hectares in Tai Po. It will be developed in three phases over a period of 15 years. The first phase, at an estimated cost of $3.3 billion and covering a site of 8 hectares, will be opened in 2001.

Technological Infrastructure : Private Sector

Industrial, Business and Professional Bodies

6.15 Some industrial, business and professional bodies in Hong Kong have a limited capability to provide technical support to their members. Many organise activities, e.g. seminars and studies to

disseminate information about technology relevant to their trade or profession. They may also organise technology-related training courses. A few may initiate R&D projects in collaboration with the universities or the HKPC to introduce new technologies to their trade.

Private Firms

6.16 Most of the firms in Hong Kong are small and medium-sized enterprises. Generally speaking, there is a weak R&D culture in industry. Only a small proportion of Hong Kong's manufacturing firms engage in any significant R&D activities, and often such activities are confined to product development. Similarly, firms in the service industries generally conduct little R&D although many larger firms are aggressive in acquiring new technologies to reduce cost or add value to their products. Only a small number of multinational companies in Hong Kong have R&D facilities locally. Some Mainland technology-based enterprises operate actively in Hong Kong but most of their R&D activities are performed in the Mainland.

6.17 As regards human resource development, many of the firms in Hong Kong pay little attention to upgrading the technological knowledge and skills of their employees[9]. This is particularly true for small and medium-sized firms.

Missing Link in Midstream Research and Development

6.18 Hong Kong has no technological infrastructure in respect of midstream R&D. Midstream R&D capability is important in developing concepts and innovative ideas into pre-competitive and generic technologies for eventual commercialisation by firms. It is also important for developing 'infrastructure technology', e.g. measurement and test methods used in research, production control and calibration of equipment. At present, the private sector performs

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[9] According to the 1996 World Competitiveness Yearbook, Hong Kong firms spend much less on

negligible midstream R&D because of their high investment cost and risky, longer term returns to individual companies. The universities perform only limited midstream R&D because such activities may not be relevant to their basic missions - education and advancement of knowledge – or academically challenging.

training than do their counterparts in other leading East Asian economies.

6.19 Without a strong midstream R&D capability in the technological infrastructure, industry has serious difficulty in turning innovative ideas or scientific research results into commercial products.

Setting up an Applied Science and Technology Research Institute

6.20 To address the problem, we recommend the setting up of a publicly-funded applied science and technology research institute to conduct midstream R&D. The establishment of this institute is justified because -

(a) the gap is too wide to be bridged by strengthening the capability of the universities and industry alone;

(b) although the HKPC has some capability in technology development, it has a wide remit and lacks the focus or expertise to conduct midstream R&D;

(c) the institute will be conducive to bringing together relevant research resources in the universities and industry to tackle specific problems; and

(d) virtually all industrialised economies and the newly industrialised economies in East Asia have recognised the need for such kind of applied research institutes as part of their technological infrastructure[10].

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[10] For example, the Industrial Technology Research Institute in Taiwan; the Korean Advanced Institute of Science and Technology in Korea; and thirteen industry-specific research institutes and centres in Singapore, of which nine were established in the first half of this decade.

6.21 We suggest that the proposed institute should have the following main functions -

(a) to perform midstream R&D[11], focusing on development and adaptation of generic and pre-competitive technologies for transfer to industry;

(b) to be an avenue for university graduates who aspire to become research scientists or engineers to obtain post-university industrial research training;

(c) to be a focal point for attracting R&D personnel outside Hong Kong to work here; and

(d) to complement the future Hong Kong Science Park, in terms of supplying technology capability and human resources.

6.22 The establishment of the proposed institute with the above functions may necessitate a critical review and rationalisation of the role and functions of the HKPC to enable it to fulfil its mission more effectively. The scope of activities of the HKPC has expanded in recent years into diverse areas of technology development as a 'stopgap' to meet the demand for midstream R&D. Prima facie, it is desirable for the HKPC to focus on its promotional, advisory, and technical support functions, with priority of practical service to be given to small and medium-sized enterprises. In the second phase of our work, we shall study in greater detail the role and functions of the HKPC in the technological infrastructure of Hong Kong.

6.23 Given that resources will always be limited, the proposed institute should focus on some selected areas that match the strengths of Hong Kong and respond to industry needs. The institute should

[11] Where appropriate, the institute may undertake some downstream R&D, particularly in the early stages of its establishment.

work closely with both industry and academia. This will require a strong representation from industry and academia in its management, which may take the form of an independent board to be established by law. Ideally, arrangements should be made to enable both university and industry people to work in the institute on an ad hoc or secondment basis. There should be a vigorous system of periodic external evaluation of the performance of the institute in terms of the relevance of its R&D outputs to industry and its efficiency.

6.24 The proposed institute can be seen as complementing the university's functions in R&D and manpower development in the technological infrastructure. We consider that the capital cost of the institute should be borne by the Government. The operating budget of the institute may be financed from three sources -

(a) recurrent provision from the Government to meet core operating expenses plus part of its R&D activity;

(b) the ITF recommended in Chapter Five or other funding sources to finance a significant proportion of its R&D projects (including research staff cost), to be selected on a competitive basis against projects submitted by other research bodies, e.g. universities; and

(c) income from contract research and technology transfer to industry.

6.25 As a key component of the technological infrastructure in the crucial midstream area, the proposed institute should be well provided for in terms of R&D staff and facilities. To create a critical mass and to make a real impact on technology development and commercialisation in industry, the institute should have a sizeable complement of research scientists and engineers. We suggest that the Government begin quickly a detailed planning study to define the physical and staffing requirements of the institute for the short, medium and long term. For a start, we consider it appropriate for the institute to have a core staff of 250 – 300 (for administration, support and R&D),

supplemented by at least the same number of R&D staff for projects financed by the ITF or other funding sources. We believe that in the long run the institute should have a size and quality commensurate with Hong Kong's economic strength and role as a regional centre of innovation and technology.

6.26 Since the institute will be a natural complement to the Hong Kong Science Park, there may be merit in locating the institute close to the Science Park. To leverage technological resources in the Mainland, there may also be merit for the institute to set up a branch in, say, Shenzhen, and establish partnership with research institutions in Beijing, Shanghai and other cities.

Technical Advice and Support to Industry

6.27 Another important aspect of the technological infrastructure that warrants our detailed examination is how technical advice and support to industry could be strengthened, particularly in helping small and medium-sized firms to acquire and apply new technologies, and in nurturing young technology-based companies. The main technology support agencies in our technological infrastructure are the HKPC, the HKITCC, the HKIB, the Standards and Calibration Laboratory and the future Science Park. We shall review the role and functions of these agencies individually and collectively in the next phase of our work, in the light of our deliberations in all relevant areas.

CHAPTER SEVEN

ENHANCING TECHNOLOGICAL COLLABORATION WITH THE MAINLAND

(This chapter recommends measures to strengthen technological collaboration between Hong Kong and the Mainland.)

7.1 The rich technological resources in the Mainland potentially are an important source of input to industry for innovation and technology upgrading. The human talents and research capability of the Mainland supplement the relatively weak R&D capability of Hong Kong. The Mainland's scientific research results offer potential opportunities for commercialisation by Hong Kong entrepreneurs.

7.2 We consider that industry should be the main driving force for leveraging the technological resources in the Mainland, and individual companies should make decisions for specific projects having regard to their market potential and feasibility. The Government should provide policy encouragement and support, communicating to the community the strategic importance and benefits of such collaboration. Furthermore, the Government should provide the necessary support infrastructure, help disseminate information and build networks, and solve generic policy-related problems affecting effective utilisation of Mainland resources by industry. In appropriate circumstances, the Government should also provide financial support for furthering the above objectives.

Current Programmes : an Overview

7.3 We note that the Government, through the Ind D and quasi-government bodies, has been promoting and facilitating technological collaboration with the Mainland through various programmes and activities.

(a) Encouraging joint research

Through the ISF scheme, the Government encourages and provides financial support for joint research conducted by Hong Kong's higher education or industry support institutions and Mainland institutions that is beneficial to industrial and technology development in Hong Kong. Between 1994 and 1998, the ISF provided $100 million for 22 such co-operative projects.

The UGC and RGC also support technological exchanges and joint research between universities or institutions in the two places. For example, some of our universities have established joint laboratories with the Chinese Academy of Sciences (CAS) or other Mainland universities in different areas of science and engineering. Many of the research activities in these laboratories are partially funded by the RGC.

Box 7-1
Hong Kong-Mainland Joint Research :
Screening of Chinese Medicine with Anti-tumour and Cardiotonic Properties

The **Chinese University of Hong Kong**, in collaboration with the Shanghai Institute of Organic Chemistry and the Hong Kong Institute of Biotechnology, is developing a technology for efficient and large-scale screening of saponins derived from traditional Chinese medicine with anti-tumour and cardiotonic properties. The aim is to identify saponins with these properties for further development into health food supplements

or therapeutics. The project is supported by a grant of $2 million from the ISF.

(b) Providing Venture Capital

Under the ARF scheme, the Government provides equity capital or loans to Hong Kong firms undertaking technological ventures or R&D projects with good commercial potential, including joint-venture projects with Mainland research or tertiary institutions.

In 1995, the Ind D signed a Memorandum of Understanding with the CAS under which the CAS will encourage and help its researchers and research institutions to collaborate with Hong Kong companies to develop technological ventures that may benefit from the scheme.

Box 7-2

Hong Kong-Mainland Technological Joint Venture :

Dietary Supplements Based on Chinese Medicinal Products

Pharmakon International Laboratory Ltd. is developing a line of traditional Chinese medicinal products which will be marketed as dietary supplements in overseas markets including the United States. This company has put together an extensive R&D programme involving two research institutes in the Mainland (China Pharmaceutical University and Jiangsu Provincial Institute of Materia Medica), four universities in Hong Kong (Chinese University of Hong Kong, Hong Kong Baptist University, Hong Kong University of Science and Technology, and University of Hong Kong), and the Centre for Alternative Medicine of the National Institute of Health located at the University of California, Davis. The ARF has provided $20 million in loan and equity participation to cover one-third of the project cost.

(c) Dissemination of information and networking

The Ind D and quasi-government agencies, such as the HKPC, the HKITCC and the Hong Kong Trade Development Council (HKTDC), engage in various activities to promote awareness in industry about opportunities for collaboration with the Mainland and to facilitate networking between the two sides. These activities include holding seminars, exhibitions, studies and visits. The ISF has provided financial support for a number of such activities.

Industry's Interest

7.4 Hong Kong industry has a positive interest in tapping Mainland technology resources to enhance its competitive edge. A number of our bigger manufacturers have established R&D centres in the Mainland. Some large enterprises have also moved their less location-sensitive technical support operations there. Many companies are interested in recruiting Mainland professionals to work in Hong Kong but their interest is to some extent constrained by existing immigration and employment policies.

Box 7-3
Tapping Mainland Technological Resources : Group Sense International Ltd.

Group Sense International Ltd., a publicly listed company in Hong Kong, is a market leader in the development, manufacture and marketing of electronic dictionaries. Its R&D facilities in the Mainland have over 300 research engineers. Group Sense licensed from the Institute of Automation of the Chinese Academy of Sciences a technology for recognition of handwritten Chinese characters with which the company developed a new generation of electronic dictionaries with Chinese character recognition functions. The company paid several million dollars in licence and royalty fees for this technology which was considered the best among technologies available in the United States, Taiwan and Hong Kong at that time.

7.5 Generally speaking, Hong Kong companies have yet to show a keen interest in engaging in joint R&D work with Mainland institutions, or in the commercialisation of Mainland research results. This is partly due to the relatively weak R&D culture in Hong Kong. Industry

also perceives some general difficulties in such collaboration.

Specific Recommendations

7.6 In the sections below, we suggest some measures to promote and help industry to utilise the technological resources in the Mainland.

Dissemination of Information and Networking

Technological Resource Database

7.7 The Mainland has a large number of research institutions and laboratories with capabilities in a wide range of technology and industrial areas. The volume of research results produced by these bodies is enormous and is growing over time[12]. We note that there is currently no systematic cataloguing of these resources for convenient access by industry. To bridge this information gap, we recommend the establishment of a comprehensive electronic database of Mainland technological resources. The proposed database should as far as possible make use of existing database resources where available. It should also have user-friendly searching functions and be updated periodically. It would also be desirable for the organisation maintaining the database to provide value-added technical assessment and consulting services to users.

7.8 We recognise that setting up the proposed database would be an enormous task and suggest that a phased approach be adopted, focusing initially on some selected sectors that are particularly relevant to Hong Kong. We also suggest that an organisation with relevant expertise should be commissioned to study and implement the project.

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[12] According to an estimate quoted by the China Chamber of International Commerce (HK) Representative Office, in Beijing alone there are 800 research organisations and laboratories with over 30 000 technology-related patents.

As the proposed database develops over time, it will be one of the important tools to help Hong Kong position itself as a marketplace for technology transfer between the Mainland and the rest of the world.

Promotion and Networking

7.9 At present, promotion and networking activities such as seminars, study missions and trade fairs are organised from time to time by quasi-government bodies and trade, industrial or professional organisations. We encourage these organisations to organise more of such activities. Where appropriate, the Government should provide funding support to them. We note that while they are located farther away from Hong Kong, cities such as Beijing and Shanghai have a strong research culture and technological capability. We encourage Hong Kong enterprises to establish closer links with research institutions in these cities. Publicising success stories of Mainland-Hong Kong collaboration is an effective way to stimulate interest in industry about such collaboration.

Liaison Mechanism

7.10 To facilitate collaboration in general and the dissemination of information and networking in particular, we recommend that the relevant bodies in Hong Kong (e.g. Ind D, HKPC, HKTDC, HKITCC and major trade and industrial organisations) seek to establish a collective mechanism for liaison with the relevant bodies in the Mainland, both at the central government level and with Guangdong. The main functions of this liaison mechanism will be -

(a) to exchange information and views on relevant policies and activities in the two places;

(b) to address generic problems faced by interested parties; and

(c) to help identify opportunities for co-operation between research institutions in the Mainland and Hong Kong enterprises.

Such a mechanism may take the form of an annual meeting of high-level representatives from the two sides, to be complemented by liaison at the working level as the need arises. In conjunction with the annual meeting, a conference might be organised to bring together interested parties from the two sides to exchange ideas and identify concrete projects for co-operation.

Technological Support Infrastructure

7.11 Closer co-operation between Hong Kong and the Mainland in the area of technological support infrastructure would create synergy and bring benefits to both places. Such co-operation may include -

(a) joint research conducted by Hong Kong's higher education or industry support institutions and Mainland institutions that is beneficial to industrial and technology development in Hong Kong;

(b) co-operation with relevant Mainland authorities to promote and assist in upgrading the technology level of production facilities of Hong Kong firms in the Pearl River Delta area;

(c) co-operation between the future Hong Kong Science Park and its counterparts as well as research institutions in the Mainland; and

(d) academic and technological exchanges between the two places to foster cross-fertilisation of ideas.

We recommend that the relevant organisations be encouraged to initiate or intensify efforts in co-operation with Mainland bodies in their respective areas of activity.

7.12 The applied science and technology research institute proposed in Chapter Six, if established, should actively form partnership with research institutions in the Mainland. Such partnership will not only enable the institute to leverage the rich pool of human talents and research capability in the Mainland, but will also assist in the commercialisation of Mainland research results.

7.13 As technological exchanges and co-operation between Hong Kong and the Pearl River Delta area intensify, there will be a growing need for frequent contact and interaction between research

scientists and engineers of the two places. The experience of the Silicon Valley has shown that such interaction is an important factor underpinning the flourishing innovative ideas and technological prowess of the Silicon Valley. This calls for government action to ease cross-border travel of research scientists and engineers in the two places. We note a suggestion to develop a cross-border high-tech zone to facilitate the interaction and networking of research scientists and engineers, and the significant implications of this suggestion on a number of important issues. We believe nonetheless that the need for closer interaction between research scientists and engineers in the two places should be taken into account in the territorial development plan of Hong Kong for the longer term.

Financial Support for Promoting Collaboration

7.14 At present, the Government provides financial support for a variety of projects related to technological collaboration between Hong Kong and the Mainland. These include joint research, joint venture for commercialisation of research results, market/technology study and networking activity. By and large, it appears that the present funding support programmes should be able to cater for the needs of the market. We recommend that the Government ensure adequate funding for these programmes and step up the publicity to encourage more applications to come forward.

7.15 Since technological exchanges and joint research between higher education institutions in Hong Kong and the Mainland are conducive to collaboration between the two places, we suggest that the UGC and RGC review whether the current funding arrangement for such activities may be improved to meet changing needs.

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CHAPTER EIGHT

FOSTERING UNIVERSITY-INDUSTRY COLLABORATION

(This chapter reviews the current state of collaboration between the universities and industry in research and development, and recommend various measures to stimulate greater collaboration.)

University Research : an Overview

8.1 Until quite recently, there was only a limited research culture in our universities[13]. Indeed, in 1991-92, only 1 600 or 50% of the academic staff themselves held a higher degree by research. That situation is changing, partly because the recent major expansion of tertiary education has led to the recruitment of many new staff and partly because of substantially increased government funding for research. Academic staff holding a higher research degree doubled to 3 200 in 1997-98. Table 8-1 illustrates the marked growth in research activity in recent years.

Table 8-1
Growth in University Research Activity

Year	Value of ongoing research projects ($ million - money of the day)
1988-89	183
1989-90	290
1990-91	385
1991-92	541
1992-93	847
1993-94	1,187
1994-95	1,568
1995-96	2,103
1996-97	2,743

[13] Refer to higher education institutions funded by the University Grants Committee.

8.2 In 1996-97, total expenditure from all sources on research projects, contracts, staff and studentships in our universities amounted to $3,176 million. This represented approximately 0.27% of Hong Kong's GDP. As a comparison, the expenditure on R&D conducted by higher education institutions in the United States and Japan is roughly 0.27% and 0.6% of GDP respectively.

8.3 University research in Hong Kong is funded mainly from public sources. These include the UGC, the RGC, the ISF and a few other funding schemes. Some research activities are also financed by private donation/sponsorship, educational trusts or overseas sponsorship.

8.4 Through the UGC, the Government gives an annual block grant to each university[14]. Each university is expected to use about 20% - 25% of this grant to support its research activities. The money is used mainly to meet the salary and other costs of research staff and the cost of the institution's research infrastructure. A relatively small amount is used as research grants for individual research projects.

8.5 The establishment of the RGC in 1991 to provide a competitive mechanism for the disbursement of research grants has significantly contributed to cultivating a research culture in the universities. Apart from competitive grants, the RGC allocates a sum to each institution for funding projects at the latter's discretion, and a small sum for funding research facilities/equipment involving two or more institutions. Between 1991-92 and 1997-98, the funds available to the RGC for research grants increased from $100 million to $423 million, representing an annual increase of 20% in real terms. The funds earmarked for each of the next three years remain the same as for 1997-98.

8.6 The RGC approves projects primarily on the basis of their academic merit. Broadly equal emphasis is given to basic and applied

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[14] The total block grant to the universities amounts to $11 billion a year from 1998-99 to 2000-01.

research. Generally speaking, industrial relevance or industry support is taken into account in the selection but is not an over-riding factor. A majority of the approved research projects are in the science and engineering fields.

8.7 The RGC also monitors the performance of research projects which it has supported. Of the completed projects assessed in 1997, 11% were rated excellent, 83% satisfactory and 6% unsatisfactory.

Interaction with Industry

8.8 In recent years, there has been a growing interest on the part of university researchers to do work with relevance to industry. This is due in part to the policy encouragement by the UGC and individual institutions, and in part to the launching of the ISF and SSF that provide additional funding for such work.

UGC's policy

8.9 In its overall review of higher education in 1996, the UGC has laid down two objectives for university research -

(a) to advance human knowledge and keep the knowledge base in the universities current; and

(b) to achieve symbiosis with industry, commerce and government, and with local culture and society.

With regard to (b), the UGC expects the universities to continue to increase the proportion of research work which is linked with the interests of the community and to carry out more of it with local partners, both active and passive. Moreover, the universities are encouraged to seek non-UGC sources of funding for such work.

Industrial Support Fund

8.10 The universities have responded to the ISF scheme enthusiastically since its inception in 1994. Between 1994 and 1997, the ISF allocated $378 million for 121 projects undertaken by the universities. The universities' share of the total allocation has been increasing, accounting for roughly half of all approved ISF funding in the last two years.

8.11 Quite unlike the criteria adopted by the RGC for approving research projects, ISF projects are approved on the basis of their potential contribution to industry. Academic merit is not a relevant factor and priority is given to projects with industry support. Most of the ISF projects undertaken by the universities are related to technology, product or process development. In addition, the ISF has financed the establishment of technology research centres in some universities. Given the relatively short history of the ISF, only a limited number of projects have been completed and their results disseminated to industry. Nevertheless, there have been some significant successes.

Box 8-1
University-Industry Collaboration in Technology Research Centre

The **Hong Kong University of Science and Technology** has established a **Consumer Media Laboratory** to develop new technologies in consumer electronics relevant to the needs of Hong Kong industry. Projects that the Laboratory is working on include, for example,

- 2.4 GHz high fidelity wireless audio
- 2.4 GHz wireless local area network
- Dimmable compact fluorescent light
- Interactive toys (convergence of entertainment, electronics and networks)

The Laboratory was set up with a grant of $14.7 million from the ISF. Six local manufacturers have pledged a total sponsorship of $4.8 million to the Laboratory. These manufacturers also send their engineers to participate in its R&D activities.

Box 8-2
University-Industry Collaboration :
Complex Fermentation Process in Soy Sauce Production

With an ISF grant of $3.6 million, the **University of Hong Kong and Amoy Food Ltd.** have jointly undertaken an R&D project to determine the biotechnological control of fermentation processes for producing soy sauce and characterising the flavours found in soy sauce. The project has resulted in the development of modernised fermentation processes and advanced techniques to analyse quickly the flavour and taste compounds in soy sauce. A computer database has been created cataloguing the taste components of soy sauces made in different parts of the world, providing important information about flavour requirements in different markets.

The project results help the soy sauce industry to improve substantially the efficiency and quality-control of production, as well as to develop niche products and new markets. At least two manufacturers have set up new production lines based on these results.

Services Support Fund

8.12 Only a small number of research projects proposed by the universities have been approved for funding by the SSF, despite a strong interest from university researchers to tap the SSF. We note that the low success rate has been due to insufficient understanding by applicants of the selection criteria and the relatively weak industrial linkage of the applications.

Co-operative Research Centres Scheme

8.13 The RGC introduced a Co-operative Research Centres (CRCs) Scheme in 1993 which aims to stimulate and encourage the university and industry to collaborate in applied research and meet industry needs. The Scheme has allocated $16 million for setting up seven CRCs since 1993. It will allocate a further $20 million over the next three years for this purpose.

Technology consulting and contract research

8.14 Some university researchers undertake technology consulting or contract research for private companies, either in their individual capacity or through consulting companies established by the university concerned. Under existing institutional rules governing academic staff's outside practice[15], staff are free to undertake such work provided it is not at the expense of their primary academic and administrative responsibilities to their institutions.

Commercialisation of research results

8.15 Some universities actively assist their academic staff to commercialise their research results through technology licensing or joint venture with the private sector. As many research results cannot be readily converted into marketable products or services, some universities provide technical assistance and facilities to the staff to do further developmental research, either on their own or in co-operation with private companies. Some universities may even provide seed capital for such work, and a few have been able to obtain venture capital from the ARF.

Box 8-3
Commercialisation of University Research Results :
Robot for Cleaning Water Ducts

Pearl Technologies Ltd. has developed an underwater robot for the inspection and cleaning of water ducts, pipes and sewers. In addition to its low cost, the robot is safe and easy to use because it is remotely controlled by an operator through an ultrasonic communication link capable of receiving video pictures from the robot. This company received an equity injection of $4.6 million from the ARF.

The company is a joint venture of the CityU Enterprises Ltd., the Harbin Institute of Technology and a British company. The CityU Enterprises Ltd. is wholly owned by the **City University of Hong Kong** and serves as a vehicle for the university to commercialise research results of its staff members.

[15] Institutions normally allow academic staff to do outside work for not more than one day per week.

General Observations

8.16 Despite a relatively late start, our universities have made good progress in establishing a research culture. Individual universities have responded positively to the UGC's policy of encouraging closer university-industry collaboration. By and large those institutions that have set their mission to develop close links with industry or to contribute to Hong Kong's economic development are more proactive in pursuing such collaboration.

8.17 We note the criticism in some quarters that the universities have engaged too much in basic or upstream applied research that produces little practical benefit to industry. Some others have argued, however, that the principal aims of the university are education and advancement of knowledge. Thus, academic disciplines, academic staff and students should be the major beneficiaries of research in order that the results may further strengthen the university's teaching and research capability.

8.18 On balance, given the educational nature of the university and the understandably academic orientation of university research staff in general, we consider it not appropriate or realistic to demand university researchers to focus on research near to the market end of the R&D spectrum. Nevertheless, university research can still play an important role in fostering innovation and technology development because it -

(a) strengthens the science and technology base of the economy;

(b) trains new generations of scientists and engineers conversant with the latest developments in their fields;

(c) produces results that can be readily diffused to industry due to the openness of the university setting; and

(d) may incubate new businesses, as researchers and students develop ideas with commercial potential and form new companies or take them to established companies.

It is important, therefore, to maintain a robust research culture in the universities and to continue to strengthen the universities' interaction and collaboration with industry.

8.19 We consider it equally important to encourage industry to devote more efforts to R&D and make greater use of the research resources in the university, which is a fertile ground for innovation.

Specific Recommendations

Enhancing exchange of information and ideas

8.20 To stimulate university-industry collaboration, we consider it necessary, as a first step, to foster a better understanding by industry of the research resources available in the universities, and by the universities of the needs of industry.

8.21 We observe that publicity on university research-related information has been piecemeal and low-profile. Most publicity activities are targeted at the universities themselves and the RGC, rather than industry or the community at large. We recommend that the universities be encouraged to set up an inter-university task force to co-ordinate publicity efforts on research, and to establish and maintain a central database of the research projects, interests and resources of each university for convenient access by industry. In addition, individual universities may consider adopting the following measures -

(a) strengthen the marketing and delivery of their research capabilities to industry through, for example, setting up consulting companies;

(b) publish periodic reports or newsletters on their research activities, capabilities and achievements;

(c) organise open days or exhibitions for industry at which the universities may demonstrate the fruits of their research projects;

(d) organise international conferences with industry participation with a view to introducing state-of-the-art technologies to Hong Kong; and

(e) designate a permanent place within the campus of each university for exhibiting its research projects and achievements.

8.22 To encourage the universities to reach out to industry and to increase their understanding of the needs of industry, we recommend the following measures -

(a) industrial organisations and universities should be encouraged to set up a forum to bring together industrialists and university researchers to discuss and identify research topics relevant to solving practical problems or developing new products or services. An industry 'wish list' may be compiled and updated regularly for reference by university researchers;

(b) the universities should be encouraged to establish a system of industrial sabbatical for staff to foster stronger interface and cross-fertilisation of ideas;

(c) the universities should be encouraged to allow staff to take no-pay leave to engage in technology-transfer or entrepreneurial work without being disadvantaged in terms of promotion; and

(d) industry input to the universities in the funding of applied research should be enhanced.

Stimulating Greater Interest in Commercially Relevant Research in the Universities

Promoting greater interaction between universities and industry in research

8.23 At present, the UGC's annual block grant to the universities account for three-quarters of the total funding for research available to them. The methodology for determining the block grant therefore plays an important role in shaping the orientation of the universities in their research activity. The block grant comprises two main elements - teaching and research. The research element of the block grant is determined mainly by reference to the outcome of a Research Assessment Exercise (RAE)[16] conducted by the UGC every three years. The next RAE will be held in 1999 and the UGC is considering various improvements to it which will be conducive to stimulating a greater interest among university researchers in commercially relevant research[17]. These improvements include widening the definition of research output to encourage the submission of non-traditional output for assessment, refining the criteria for assessment, and improving the guidelines and training for panels to recognise non-traditional research output for scoring purposes. We endorse these efforts.

8.24 We also recommend that the UGC consider building in an element, through the RAE, to reflect the level of interaction between industry and university in research projects. To build in such an element would -

(a) underline the objective of promoting greater collaboration

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[16] An outline of the Research Assessment Exercise is at Annex F.

[17] Commercially relevant research refers to research of an applied nature which is relevant to the industries of Hong Kong in terms of the potential for commercial application of its outcome.

between the university and industry; and

(b) provide an incentive for university researchers to seek greater interaction with industry.

8.25 In our view, such an element will be a measure of the research performance of the university in terms of meeting the stated objective of achieving symbiosis with industry (see paragraph 8.9). It may take into account, for example, the participation of industrial partners in the research project. We stress that the existing assessment criteria under the RAE, which focus on measuring the quality of research output, should remain in place as a measure of performance in meeting the objective of advancing knowledge and keeping current the knowledge base of the university. Furthermore, this should remain the predominant factor in determining funding because it is very important to foster a high standard of research in the universities.

8.26 We have an open mind on the precise mechanism for introducing the new element, which will need further consideration by the UGC. It may be incorporated into the current criteria for assessing whether the research outputs of individual staff merit a score, or alternatively, a separate assessment channel may be established.

Ensuring sufficient funding for commercially relevant research

8.27 The availability of ad hoc grants to meet the cost of, say, temporary research assistants and special equipment is important for many research projects. We recommend that the Government ensure the availability of funding for commercially relevant research undertaken by the universities. The ITF recommended in Chapter Five would be a concrete and positive step to this end.

Inter-university Award Scheme

8.28 To promote university research in support of commerce and industry and to foster a culture change, we recommend that relevant authorities study the feasibility of launching an annual inter-university award scheme to recognise outstanding achievements in commercially relevant research.

Career Advancement Policy

8.29 We note the view expressed in some submissions to us that career advancement in the university relies too heavily on the publishable work of staff. We are conscious that some universities already recognise the staff's efforts in commercially relevant work in considering their promotion. We recommend that the universities be encouraged to develop or promulgate a clear policy in this regard.

Promoting University-Industry Partnership in R&D

8.30 At present, university-industry co-operative projects are predominantly instigated from the university end, and academic staff generally have difficulty in finding an industrial partner to supply capital and perform further downstream R&D work necessary for the commercialisation of their research results. To address these issues, we recommend the introduction of a package of incentive measures to stimulate industry to forge partnership with the universities in R&D. This University-Industry Partnership package includes the following schemes -

(a) Matching Grants for commercially relevant R&D projects carried out jointly by private companies and universities

Private company projects eligible for support under this scheme can be at any point on the R&D chain but should

have potential high 'spill-over' benefits to the economy. In particular, the scheme will support developmental research that seeks to commercialise academic research results. Projects that focus on routine applications of existing technology or on routine analysis or collection of data without interpreting the underlying mechanisms should not be eligible. The ownership of and access to intellectual property arising from the project will be a matter between the collaborating parties, to be agreed before the project begins. At least half of the contribution from the private company must be in cash, and the rest in kind (staff, facilities or other resources).

(b) Teaching Company Scheme

Since 1990, the Hong Kong Polytechnic University has been operating a Teaching Company Scheme under which graduate research students are placed full-time in participating private companies for two years to undertake research on issues of specific concern to the company. The student receives a full salary contributed equally by the university and the company concerned. The student is guided and advised by an academic supervisor from the university as well as by supervisors from the company.

Participating companies under the scheme will benefit from the research deliverables. Students will benefit from their practical research experience in a genuine business environment. The faculty will gain from having closer links with industry and a better understanding of its problems.

We consider the scheme a good model for fostering university-industry partnership and recommend that it should be promoted to other universities.

(c) Industrial Research Fellowship Scheme

This is a variation of the Teaching Company Scheme. Under the proposed scheme, funding support will be provided to the host company to engage recent graduates of a higher research degree (graduating, say, within the past three years) in science or engineering to work on industry-based projects that might lead to commercially beneficial products or processes. A grant not exceeding a specified ceiling and 50% of the total eligible project costs may be given to the host company to cover the salary and other costs of the graduate, and a limited grant may be given to a sponsoring university (if any) for its involvement in the project.

The scheme will help recent graduates to gain industrial experience in R&D, increase the level of research activity in industry and the opportunities for highly qualified graduates to seek careers in industry, and facilitate the transfer of expertise and technology.

(d) Industrial Research Chair Scheme

Under this scheme, an applied research initiative in the university sponsored by industry may be eligible for a grant up to the amount of the contribution made by industry. The project should be in the natural science or engineering field that responds to industrial needs. The grant could cover the salary of a distinguished researcher for a finite duration (say three to five years, to be renewable if industry support continues), as well as expenditure on equipment and general expenses. The chairholder should mainly conduct research and accept a light teaching load.

The objective of the proposed scheme is to assist universities and industry to develop research efforts in technology fields that have not yet been developed in Hong

Kong but for which there is good development potential for our industry in the longer term.

8.31 It is important to put in place some business management discipline for these schemes. We recommend that all approved projects should be subject to a mid-term evaluation (say at the end of two years for a five-year project) to determine whether funding should continue. We believe that this arrangement could significantly improve project performance and efficiency.

Technology Research Centres in Universities

8.32 The setting up of technology research centres in the universities can provide a natural focus for solving industry problems, as well as supporting and complementing near-market R&D efforts in industry. We encourage the establishment of such centres. We must emphasise, however, that a university should set up a technology research centre only if it has demonstrated research excellence in the discipline concerned and is prepared to commit human and financial resources to it on a long-term basis. The centre should also maintain tangible and close connections to, and be supported by, the relevant industries.

Technology Incubators in Universities

8.33 Technology incubator schemes provide low-cost, property-based facilities and shared services to nurture the emergence of innovative and technology-based firms. There has been a growing trend to link technology incubators more closely to higher education or research institutions. Creating such links would facilitate access to technical facilities, libraries and databases, as well as cross-fertilisation of ideas between incubatees and faculty members and students. It would also help in technology transfer and diffusion while encouraging entrepreneurship among academic researchers.

8.34 In addition to operating its own in-house business incubation programme, the HKITCC operates jointly with the Hong Kong University of Science and Technology a 'distributed incubator centre' on the campus of the latter. The HKITCC is discussing with the University of Hong Kong to establish another such centre. We recommend that the distributed incubator centre concept be encouraged and further promoted to other universities.

8.35 Some universities may be constrained by a lack of physical accommodation for establishing an incubator centre. In this regard, there may be a case to improve slightly the planning standard for relevant university accommodation. In the interim, we recommend that the possibility of acquiring accommodation near to the university campus for the incubator centre be explored.

CHAPTER NINE

ISSUES FOR STUDY IN THE NEXT PHASE

(This chapter outlines the issues to be examined by the Commission in its next phase of work.)

9.1 Owing to time constraint and the need to give each issue in-depth consideration, we have only focused on some of the issues that are relevant to our remit in the first six months. We set out in this chapter the outstanding issues and the general direction in which we shall approach these issues in the next phase.

Equipping Hong Kong with Requisite Human Capital

9.2 To serve as a centre of innovation and technology, Hong Kong must possess the human resources capable of meeting the requirements of the fast-changing, knowledge-based economy of the 21st century. We have identified a number of broad issues relevant to this area of our study.

Education

9.3 Education is a fundamental measure in cultivating the innovative abilities of our workforce. It also provides them with knowledge and the ability to use information and technology, both of which are key elements in creating wealth and employment in a knowledge-based economy. We recognise that education-related issues are wide-ranging and complex, deserving dedicated study on their own by experts in the field. We have therefore decided not to go into detailed examination of educational issues. Instead, we highlight in

this report a number of matters of concern for further consideration by relevant educational bodies.

9.4 First and foremost, we consider it important for our education system to put emphasis on broad-based education. This applies to both the basic and tertiary education sectors, but especially to basic education. An all-round education is essential to nurturing the development of creative mind and innovative thinking. In addition to basic academic knowledge and technical skills, our students should be equipped with conceptual, analytical, and communication skills, as well as the skills to acquire and adapt new knowledge in the future. Fostering a culture of continuous learning and improvement is especially important in our fast-changing economy. Communication skills are also essential to learning, interaction and innovation. A priority area is to improve the language ability of our students.

9.5 The knowledge-based economy is characterised by the production, distribution and use of knowledge and information. An increasingly large proportion of the workforce will be engaged in handling information as opposed to more tangible factors of production. There is an urgent need to strengthen education on information technology so that our students can master the basic skills for future learning and for the workplace.

9.6 We recognise that the Government has accorded top priority to improving education in Hong Kong and we fully endorse it. It is our strong conviction that the Government should continue to invest heavily in education, paying particular attention to the issues mentioned in paragraphs 9.4 and 9.5.

Building up manpower for technology development, commercialisation and use

9.7 A prerequisite for technology development and commercialisation is the availability of the manpower needed to conduct R&D work. At present, our universities offer some 3 600

research postgraduates places, constituting about 5% of the total tertiary student numbers. However, about one-third of these places are taken up by non-local students because of a lack of local graduates who are qualified and willing to pursue research postgraduate studies. There is a need to cultivate interests in science and technology among Hong Kong's younger generation, so that more of them will take up courses in these fields. The objective is to increase the number of our science and engineering students, including some of the best, pursuing postgraduate research studies with a view to a career in R&D. We shall examine how this should be pursued in the next phase of our work.

9.8 We believe that the Government should encourage industry to pay more attention to manpower development. It already offers generous tax incentives for such purpose. Its New Technology Training Scheme also provides financial support for companies to send their employees to acquire new technologies. We shall examine what more should be done.

Attracting technological talents to Hong Kong

9.9 In its post-war economic development, Hong Kong has benefited significantly from a large pool of entrepreneurs and skilled and motivated workers from the Mainland. In addition, Hong Kong has a sizeable expatriate business community which brings to Hong Kong new ideas, technical know-how and advanced management practices from all over the world. These are important contributing factors to the development of Hong Kong into the international business centre it is today.

9.10 Likewise, if Hong Kong is to develop into a technology-based economy, besides nurturing a pool of indigenous resources it is essential for Hong Kong to be able to attract high-calibre scientists and engineers from other places to build up its intellectual capital. Indeed, the Silicon Valley benefits from the best talents from all over the United States and the rest of the world. In both Taiwan and Korea, the return of scientists and engineers who have studied and worked in the

United States and other advanced countries contributes significantly to the technology development of the two economies. Singapore has adopted an aggressive policy to attract foreign research scientists and engineers to its industry and academia. The Singapore experience is especially relevant to Hong Kong because both places have a small population.

9.11 A major potential asset of Hong Kong is the rich pool of Chinese scientists and engineers who live in the Mainland or who are studying or working overseas. We shall examine what measures should be introduced to tap this potential. We are particularly concerned about the existing situation where research postgraduate students from the Mainland must leave Hong Kong after completing their postgraduate study here. We believe that there is a prima facie case to relax the current rules to enable Hong Kong to benefit from its investment in these people.

Fostering a Culture of Innovation and Technology

9.12 A major task of the Commission is to identify measures to stimulate dynamism in industry for innovation and upgrading by introducing more sophisticated technology and methods, by penetrating more advanced market segments, and by entering into higher value-added activities.

9.13 There has been no comprehensive and systematic study of the levels of innovation and technology of Hong Kong firms. Based on fragmented evidence and opinion surveys, it appears that in general Hong Kong firms are relatively strong in management and process innovation, but weak in technology development, commercialisation and utilisation. The strengths of Hong Kong firms in management and process innovation are reflected in their unrivaled entrepreneurial spirit, highly flexible organisations and strategies, rapid responses to customer demand and sophisticated packaging and integration capabilities.

9.14 Hong Kong firms are generally quite efficient in using well-established technologies and have been introducing automation and computer-aided technologies in production processes. However, with a few exceptions, they are weak in the development and widespread application of new technologies. This is mainly due to the following three reasons -

(a) most of our firms are small and medium-sized enterprises that tend to adopt a short-term outlook, and avoid investment in technology which often requires a longer timeframe to yield returns. This has been exacerbated in the past decade by the availability of other investment opportunities with quicker and more lucrative returns, particularly investment in property;

(b) by relocating their production to the Mainland to leverage low-cost land and labour there, our manufacturing firms have managed to increase their competitiveness, thereby mitigating the pressure to upgrade their technology; and

(c) our manufacturing firms are mainly engaged in light consumer industries and adopt original equipment manufacture strategies which require relatively small investment in R&D.

9.15 There are no official data on private sector expenditure on R&D in Hong Kong. According to some estimates, the spending is about 0.1% of GDP. This is much smaller than that of the United States (1.8% in 1996) or Singapore (0.9% in 1996). According to a 1994 survey by the Federation of Hong Kong Industries, only 30% of its members performed R&D activity and the R&D spending of 83% of them was below $5 million a year.

9.16 The weak R&D culture and technological capabilities of our firms have created serious difficulties for them to turn innovative ideas or academic research results into higher value-added products or services. As a result, many of our firms continue to rely on price-

oriented strategies and compete in price-sensitive market segments.

9.17 In the next phase, we shall examine how the Government can foster a culture of innovation and technology in industry. We believe that it is important to change both the image and mindset of Hong Kong. We shall look at measures to increase public awareness about the importance of innovation and technology to productivity growth and competitiveness. We shall also examine how to present a new image of Hong Kong to the international community, so that we can attract multinational companies to set up world-class R&D facilities in Hong Kong. We shall consider the need for providing financial and other incentives to industry for pursuing technology development, commercialisation and use. We shall also study what measures should be introduced to promote co-operation among firms in addressing technology issues so as to pool resources and share risks.

Maintaining a Conducive Business Environment

9.18 Under this broad area, we shall examine the following issues in the next phase –

(a) stimulating the development of a capital market for financing innovative commercial activities;

(b) strengthening support for technology sourcing and acquisition;

(c) reviewing and identifying any unnecessary administrative barriers with a viewing to removing them; and

(d) examining issues related to protection of intellectual property rights.

Institutional Arrangements

9.19 As mentioned in Chapter Six, we shall review the role and functions of Hong Kong's technology support bodies with a view to rationalising and streamlining their operations. We shall also examine the best institutional arrangements for steering Hong Kong towards the realisation of the new vision, in the light of our study in all relevant areas.

Submission of Second and Final Report

9.20 We plan to complete examination of all the outstanding issues and submit our Second and Final Report to the Chief Executive by June 1999.

LIST OF ABBREVIATIONS

ARF	Applied Research Fund
CAS	Chinese Academy of Sciences
CRC	Co-operative Research Centre
GDP	Gross Domestic Product
GNP	Gross National Product
ISF	Industrial Support Fund
Ind D	Industry Department
HKPC	Hong Kong Productivity Council
HKIB	Hong Kong Institute of Biotechnology
HKITCC	Hong Kong Industrial Technology Centre Corporation
HKTDC	Hong Kong Trade Development Council
ITF	Innovation and Technology Fund
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
RAE	Research Assessment Exercise
RGC	Research Grants Council
SSF	Services Support Fund
UGC	University Grants Committee
VTC	Vocational Training Council

ACKNOWLEDGEMENTS

We are grateful to the organisations and individuals who have given their valuable views and suggestions to the Commission either in response to the consultation document, or on other formal or informal occasions. They have been very useful in bringing different perspectives to our deliberations.

We thank all the participants to our workshops and luncheon talk, particularly the speakers and panellists who have so generously shared their insightful opinions with participants on many important issues relevant to our work.

Our gratitude also goes to the companies and organisations visited by us in July and September. We have gained a first-hand understanding of the opportunities and challenges faced by them. We thank the Governments of Shenzhen, Guangzhou and Guangdong Province for their generous hospitality and excellent arrangements during our visit to the Pearl River Delta region. This trip has enlightened us on the strength, dynamism and vision of the Pearl River Delta economy, and the potential for closer collaboration between Hong Kong and the Mainland.

We thank the Official Languages Agency for providing translation services to the Commission and the Printing Department for printing this report.

Last but not the least, we wish to express our appreciation to the staff of the Commission, especially Mr Kenneth Mak, the Secretary to the Commission, for their hard work and good support over the last six months.

Annex A

Terms of Reference of the Commission

To advise the Chief Executive on -

1. the steps that Hong Kong should take; and

2. the institutional arrangements that are needed to -

   (a) stimulate the exchange of ideas between university researchers, businessmen, industralists and customers so as to drive forward innovation and turn technological development into commercial products;

   (b) tap the talents and the results of scientific research in the Mainland; and

   (c) make Hong Kong an innovation centre for South China and for the region, adding value to our commercial and industrial activities and to our economic hinterland.

Annex B

Members of the Commission

Chairman — Professor Chang-Lin TIEN
NEC Distinguished Professor of Engineering
University of California, Berkeley

Members — Mr Payson CHA Mou-sing
Managing Director
Hong Kong Realty International Limited

Professor Leroy CHANG Li-gong
Pro-Vice-Chancellor and Professor of Physics
Hong Kong University of Science and Technology

Mr CHAU Tak Hay
Secretary for Trade and Industry
Government of the Hong Kong Special Administrative Region

Mr Vincent CHENG Hoi-chuen
Executive Director
Hongkong and Shanghai Banking Corporation Limited

Mr Francis HO
Director-General of Industry
Government of the Hong Kong Special Administrative Region

Professor Charles KAO Kuen
Chairman and Chief Executive Officer
Transtech Services Limited

Professor LIU Pak-wai
Pro-Vice-Chancellor and Professor of Economics
Chinese University of Hong Kong

Mr Victor LO Chung-wing
Chairman and Chief Executive
Gold Peak Industries (Holdings) Limited

Professor LU Yong-xiang
President
Chinese Academy of Sciences

Mr Henry TANG Ying-yen
Managing Director
Peninsula Knitters Limited

Dr WANG Mei-yue
Chairman and President
China Aerospace International Holdings Limited

Mr Allan WONG Chi-yan
Chairman
VTech Group of Companies

Professor Richard WONG Yue-chim
Director, School of Business and
Hong Kong Centre for Economic Research
University of Hong Kong

Miss Denise YUE Chung-yee
Secretary for Trade and Industry
Government of the Hong Kong Special Administrative Region
(until 30 March 1998)

Annex C

Consultative Document
issued by the Commission on 7 April 1998

The Commission has identified five broad sets of issues that are relevant to its tasks. The Commission invites comments and suggestions on them, so that the Commission can take them into account in formulating its recommendations to the Chief Executive.

1. Strengthening links between industry and local academia

The academia has an important role to play in the industrial science and technology policy of many advanced economies. These economies attach great importance to maintaining strong connections between research universities and industry. What should be done in the Hong Kong context ? What measures are needed to promote commercially relevant research and development in our universities and in our manufacturing and service industries ?

2. Technological collaboration with the Mainland and South China in particular

The scientific and technological resources in the Mainland potentially are an important source of input for innovation and technological adaptation to Hong Kong industries. What measures are needed to reap this potential ? What should the Government do to facilitate the commercialisation by Hong Kong' s industries of scientific research results in the Mainland ?

3. Fostering a culture of innovation

(a) To promote innovation and adaptation of new or advanced technologies, availability of the requisite human resources is essential. What measures are needed to equip Hong Kong with the human resources necessary to serve as a centre for innovation and technology ?

(b) How should a culture of innovation among our businessmen and industrialists and the society in general be fostered ?

4. Providing a business environment conducive to innovation and technology diffusion

(a) *Infrastructure support*

What additional government support measures are needed to meet the needs of innovators, nurture technological start-up companies and facilitate technology sourcing and acquisition ? What measures are needed to keep our manufacturing and service industries abreast of technological development overseas ?

(b) *Financing support*

(i) To turn innovative ideas and technological development into commercial products would require capital. What measures are needed to nurture the development of a capital market for financing innovative commercial activities ?

(ii) Within the framework of a free market, the Government provides funding support for projects that foster industrial development in general and applied research and development in particular. What additional measures are needed ?

(c) *Protection of Intellectual Property*

An effective system for protecting intellectual property rights is indispensable for carrying out innovative activities. It also allows for the widest possible dissemination of new ideas without resorting to secrecy and the retention of technologies. What more can be done to reduce the cost and timescale of acquiring patents, and ease access to data on patents both in Hong Kong and overseas ?

5. <u>Enhancing exchange of ideas between industry and market/customers</u>

Hong Kong businessmen are generally famed for their quick response to market and customer demand. What can the Government do to complement and facilitate our businessmen' s efforts ?

Organisations and Individuals who responded to the Consultative Document

Organisations

American Chamber of Commerce in Hong Kong, The
British Chamber of Commerce in Hong Kong, The
Business and Professionals Federation of Hong Kong
Chartered Society of Designers (Hong Kong), The
China Council for the Promotion of International Trade and China Chamber of International Commerce (H.K.) Representative Office
Chinese General Chamber of Commerce, The
Chinese University of Hong Kong, The
City University of Hong Kong
Clothing Industry Training Authority
Corona Corporation Ltd.
Democratic Alliance for Betterment of Hong Kong
Democratic Party, The
Employers' Federation of Hong Kong
Federation of Hong Kong Industries
Federation of Hong Kong Machinery and Metal Industries
Federation of Hong Kong Watch Trades and Industries Ltd., The
HKNet Co. Ltd.
Hong Kong Article Numbering Association
Hong Kong Association for the Advancement of Real Estate and Construction Technology Ltd., The
Hong Kong Association for the Advancement of Science and Technology Ltd., The
Hong Kong Association of Freight Forwarding Agents Ltd.
Hong Kong Association of Restricted Licence Banks and Deposit-taking Companies
Hong Kong Association of Textile Bleachers, Dyers, Printers and Finishers Ltd., The
Hong Kong Chinese Enterprises Association, The
Hong Kong Chiu Chow Chamber of Commerce Ltd.
Hong Kong Coalition of Service Industries
Hong Kong Designers Association

Hong Kong Economic and Trade Association Ltd.
Hong Kong Electronic Industries Association Ltd., The
Hong Kong Exporters' Association, The
Hong Kong Federation of Insurers, The
Hong Kong Futures Exchange Ltd.
Hong Kong Garment Manufacturers Association Ltd.
Hong Kong General Chamber of Commerce, The
Hong Kong Industrial Estates Corporation, The
Hong Kong Industrial Technology Centre Corporation
Hong Kong Information Technology Federation Ltd.
Hong Kong Institute of Biotechnology Ltd.
Hong Kong Investment Funds Association
Hong Kong Leather Shoe and Shoe Material Merchants Association Ltd.
Hong Kong Optical Manufacturers Association Ltd.
Hong Kong Plastic Machinery Association Ltd.
Hong Kong Policy Research Institute Ltd.
Hong Kong Polytechnic University, The
Hong Kong Productivity Council
Hong Kong Publishing Federation Ltd.
Hong Kong Quality Management Association
Hong Kong Shamshuipo Industry & Commerce Association Ltd.
Hong Kong Shipowners Association Ltd., The
Hong Kong Tourist Association
Hong Kong Trade Development Council
Hong Kong University of Science and Technology, The
Hong Kong Watch and Clock Technology Centre
Hong Kong Women Professionals and Entrepreneurs Association
Hong Kong Young Industrialists Council
Intelligence Asia
International Federation of the Phonographic Industry (Hong Kong Group)
K. Wah Group
Pico Exhibits (Hong Kong) Ltd.
Telecom Technology Centre
University of Hong Kong, The
Yau Lee Construction Co. Ltd.

Individuals

Cheng Kwan Wai, Dr.
Cheung King Fung
Chiang Chen, Dr.
Lily Chiang, Dr.
Francis Y. L. Chin, Professor
H. C. Kwan
Lau Kwong Kai
Lee Dik Lun
Richard Li
Vincent Lin
John Lo, Dr.
M. H. Ng, Professor
Ng Shek Wai
Nicholas Ngan
Pau Kwok Ping, Dr.
So Fuk Sang
To Tsun Ping
Tuan Chyau, Professor
Kenneth Wang, Dr.
Simon Wong, Professor
Adrian Wu, Dr.
Yeung Wing Kwok
Jeffrey Ying
Yu Wing Yin

Annex D

Outreach Activities of the Commission

(A) Workshops

First Workshop on Innovation and Technology

Date : 6 May 1998

Panellists : First session on University-Industry Collaboration

Professor Ping K Ko, Dean of Engineering
Hong Kong University of Science and Technology

Dr York Liao, Executive Director
Varitronix Ltd.

Professor Simon Wong
Electrical Engineering Department, Stanford University

Second Session on Hong Kong-Mainland Collaboration

Professor Lu Yong-xiang, President
Chinese Academy of Sciences

Mr Samson Wai-ho Tam, Chairman
Group Sense (International) Ltd.

Mr Thomas Koon-yiu Tang, Executive Director
Hong Kong Productivity Council

Mr Alan Shuen-lung Cheung,
President & Executive Director
Founder (HK) Ltd.

Roundtable Workshop on Innovation and Technology

Date : 3 June 1998

Theme : Defining the Vision : Centre of Innovation and Technology

Panellists : Dr Raymond Kuo-feng Ch'ien, Chairman
Industry and Technology Development Council

Mr Henry Ying-yen Tang, Chairman
Federation of Hong Kong Industries

Professor Michael Enright, Sun Hung Kai Visiting Professor
School of Business, The University of Hong Kong

Second Workshop on Innovation and Technology

Date : 21 August 1998

Theme : Strengthening Hong Kong's Technological Infrastructure

Speakers : Professor C C Hang, Deputy Chairman
National Science and Technology Board, Singapore

Dr Shih Chin Tay, President
Industrial Technology Research Institute, Taiwan, China

Ms Deng Nan, Vice Minister
Ministry of Science and Technology, China

Mr Ji Fu-sheng, Director General
Ministry of Science and Technology, China

(B) Luncheon Talk
(co- organised with Hong Kong Venture Capital Association)

Date : 28 July 1998

Title of talk : "Can Hong Kong Become the Silicon Harbour of the Orient ?"

Speaker : Dr Ta-lin Hsu, Chairman of H&Q Asia Pacific

(C) Visits to Local Firms and Technology Support Bodies and Institutes

Date	Organisation
2 July 1998	● TAL Apparel Ltd. ● Hongkong Telecom IMS
3 July 1998	● Hong Kong Industrial Technology Centre Corporation ● Hong Kong Productivity Council
25 July 1998	● Hong Kong Institute of Biotechnology ● Chinese Medicinal Materials Research Centre of the Chinese University of Hong Kong ● Pharmakon International Laboratory Ltd.

(D) Visit to Pearl River Delta

12 September 1998

- Visited the following factories in Shenzhen and Dongguan
  - Chochuen Garment Co. Ltd.
  - TechTronic Industrial Co. Ltd.
  - SAE Magnetic (HK) Ltd.

- Called on the Executive Vice Mayor of Shenzhen

13 September 1998

- Visited the Shenzhen High Tech Industrial Park, Huawei Technologies Company, Great Wall Computer Company and GKI Electronics Company

- Called on the Mayor of Shenzhen

- Roundtable discussion with heads of Science and Technology Bureau, Foreign Investment Bureau and Hi-Tech Industrial Park Administrative Office of Shenzhen

- Roundtable discussion with the Party Secretary of Guangzhou, the Mayor of Guangzhou, and over twenty heads of universities, research institutions and technology-based enterprises in Guangzhou

14 September 1998

- Called on Deputy Governor of Guangdong

- Roundtable discussion with senior officials of Guangdong Provincial Government, Guangdong Commission of Foreign Economic Relations and Trade, and Guangdong Commission of Science and Technology

Annex E

Types of Research and Development Activities

There are different ways of classifying R&D activities. For example, the Organisation of Economic Co-operation and Development (*the Frascati Manual, 1994*) classifies R&D activities broadly into three types - basic (or fundamental) research, applied research and experimental development – with their definitions as follows -

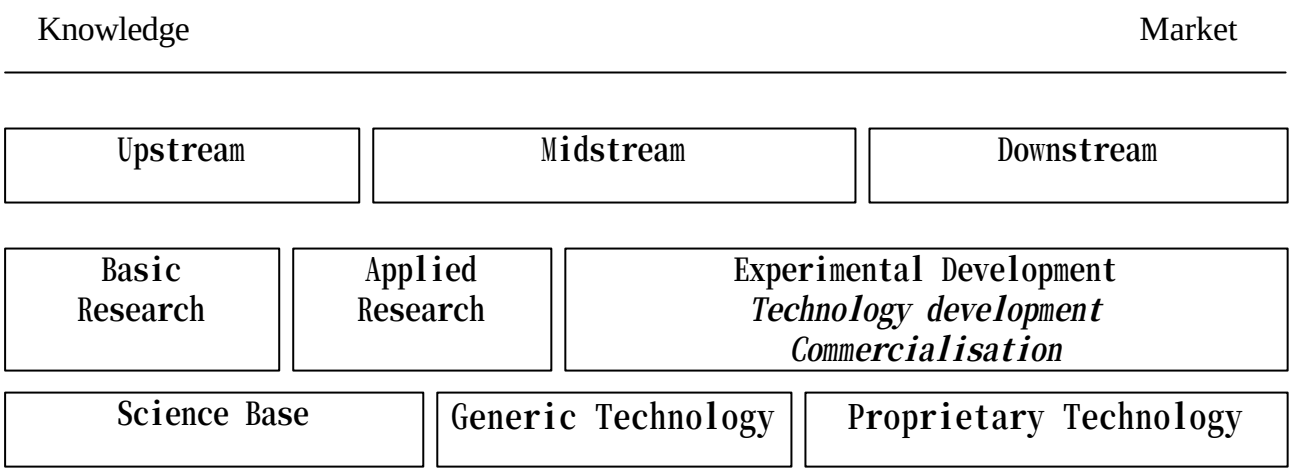
- **Basic Research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

- **Applied Research** is original investigation undertaken in order to acquire new knowledge which is directed primarily towards a specific practical aim or objective.

- **Experimental Development** is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

A simple schematic diagram of the different stages of activity in the R&D spectrum is set out below for reference.

The Research and Development Spectrum



Annex F

Research Assessment Exercise

The research element of the University Grants Committee block grant is essentially a function of the number of staff doing quality research work in each discipline of the university and the unit cost of research in that discipline. The Research Assessment Exercise (RAE) determines the number of staff whose research work is assessed to be of acceptable quality. In the RAE, the universities are invited to submit in respect of every member of their staff research output items that meet all of the following criteria -

(a) the output contains an element of innovation;

(b) the output and the process involved contribute to scholarship;

(c) the output is publicly accessible; and

(d) the output is of interest to peers and is generalisable.

The outputs will be reviewed by panels of local and international academics against a quality threshold. Those staff whose research outputs as a whole meet the threshold standard will receive a score. The outcome of the RAE will be the aggregate of these scores.

The universities place tremendous importance on the RAE as its findings are a major determinant of their recurrent research funding. While the RAE is not intended to be an assessment of individual researchers' performance and the universities are advised not to use the inferred information for internal evaluation of staff performance, the process of selecting research outputs for submission by individual universities is perceived to have the effect of evaluating staff performance. Thus, university researchers also place a lot of importance on the RAE.

Annex G

Staff of the Commission

Secretary	Mr Kenneth MAK Ching-yu
Assistant Secretary	Mr TONG Fu-keung
Executive Officer	Miss Shirley LEE Yik-fung
Personal Secretaries	Ms Jackie CHEUNG Wan-ha Ms Mandy WONG Sau-king
Assistant Clerical Officer	Mr David CHEUNG Chun-keung

Representative from Trade and Industry Bureau

Miss CHEUNG Siu-hing

Representatives from Industry Department

Miss Annie TANG Hoi-yee
Ms Annie CHOI Suk-han