Department of Education, Science and Training

Submission to the Senate Committee Inquiry into Australia's Relations with China

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The submission from the Commonwealth Department of Education, Science and Training (DEST) is in three parts reflecting the different areas of responsibility of the department. The three parts are:

1) Education and Training;
2) Science and Technology; and
3) Questacon

1. EDUCATION AND TRAINING

1.1 BACKGROUND

1.1.1 The role of AEI, DEST

Australian Education International (AEI) is part of the Australian Department of Education, Science and Training (DEST). AEI uniquely integrates the development of international government relations with support for the commercial activities of Australia's education community. To do this, AEI liaises with all sectors of the education and training industry and all levels of government.

AEI develops Memoranda of Understanding and facilitates dialogue on the issues of education, science and training with governments around the world, as well as managing Australia's education interests in major international and regional strategic fora. It has an International Network of staff including two Counsellors and four offices through China.

AEI promotes Australia's education and training capabilities through a range of strategies including brand positioning, promotional events, marketing materials, the multilingual Study in Australia website and in-country communications campaigns. AEI also administers national legislation for financial and tuition assurance mechanisms and codes of practice such as the Education Services for Overseas Students Act (ESOS) and the Commonwealth Register of Institutions and Courses for Overseas Students (CRICOS). AEI provides assessment services, information and advice on the recognition of educational and professional qualifications and skills from around the world through the National Office for Overseas Skills Recognition (NOOSR).

1.1.2 Introduction

China is a significant education and training partner for Australia. Its emergence as a regional power only adds to the significance of this relationship being strengthened and maintained in the future. China has recently stated its aim of becoming a major exporter of international education and an international education hub, which may see it become a competitor to Australia as well as a partner in the education area.

There is a range of engagement between Australia and China on education and training matters. There are many Chinese nationals who study in Australia or who access education services supplied by Australian education providers in China. The cooperative relationship also includes areas of mutual benefit such as the strengthening of linkages between the education sectors (higher education, vocational education and training [VET], English Language Intensive Courses for

Overseas Students [ELICOS], schools and professional development). These linkages are supported through DEST and the Chinese Ministry of Education (MoE) in activities at government-to-government levels (such as conferences, delegations, policy exchange), institutional levels (such as mentoring programs) and individual levels (such as scholarships).

Government to Government linkages
The formal relationship DEST has with the MoE is underpinned by the Memorandum of Understanding (MoU) on Education and Training Cooperation which was signed in December 2002. The 2002 MoU replaces previous documents of cooperation signed in 1999 and 1995. The MoU is a framework document in which DEST and the MoE identify priority areas of cooperation. The 2002 MoU established a mechanism for senior representatives of both agencies to meet and discuss areas of mutual cooperation – the Joint Working Group. Under the MoU, DEST and the MoE signed 'The Arrangement on Higher Education Qualifications Recognition' in October 2003 which aims to facilitate the mutual recognition of higher education qualifications and credit transfers.

Institution to institution linkages
There is a high level of academic and research exchange occurring between institutions in Australia and China and a growing trend in the delivery of customised training programs for academics and officials. Australia is well-placed in this area, with China favourably disposed towards Australian education models. The Australian Vice Chancellors Committee records that there are over 400 bilateral cooperation agreements developed between Australian universities and their Chinese counterparts.

1.1.3 China's Demand for International education

The Chinese national government policy is supportive of international education activity in China. The government recognises that the present education system in China cannot support the demand for education. More than 100 000 Chinese students left the country in 2002 to study overseas. The demand for overseas education is primarily limited by foreign governments' visa policies and is closely related to the ability of Chinese students to pay for their education. With continuing strong economic growth and improvement in per capita income, the proportion of families willing to invest in an overseas education will continue to increase strongly (surveys indicate that children's education leads investment choices by Chinese families).

Reform and development of the Chinese education system is a priority for the Chinese government. Foreign cooperation is seen as way in which to fast track educational development in order to meet the needs of rapid modernisation and economic reform. Cooperation with foreign education providers is a method by which institutions are able to improve the quality and scope of courses as well as institutional infrastructure.

The Chinese government has developed policies and laws encouraging the delivery of foreign education with a Chinese institution. There have also been a number of education related laws promulgated over the last ten years across all sectors. Consequently, there has been a proliferation of what are known as education joint ventures or joint programs in China. The Implementation Measures for the Regulations on Chinese-Foreign Cooperation in Running Schools (hereafter Measures) which took effect from 1 July 2004 provide administrative rules for setting up and running Chinese-Foreign cooperatively-run schools and education programs.

Most importantly, the new Measures along with 2003's Regulations raise the legal and administrative expectations for the delivery of foreign education with Chinese partners and increase the importance of the partnership arrangement. Australia is one of the most active foreign countries involved in these joint venture arrangements in China.

1.2 STUDY IN AUSTRALIA

In 2004, China represented Australia's top source country for international student enrolments. Student enrolments grew strongly by 17.6% from 58,574 in 2003 to 68,857 in 2004. [These figures refer to enrolments throughout the full year and not just to a point in time in the reference year as depicted in the following graphs and tables.] In 2004, Chinese students made up 21.3% of the total number of international students studying in Australian institutions (322,776).

Of those Chinese students enrolled in Australian institutions during 2004, 43.6%, (30,041) were in the higher education sector, 21.8%, (15,006) in ELICOS, 18.2% (12,557) in Schools and 14.2% (9,779) in vocational education and training. Of all sectors, higher education enjoyed the highest growth, up 25% from 22,394 in 2003.

DEST expects that strong growth will continue from China through 2005 but that this is almost all from the vocational education and higher education sectors.

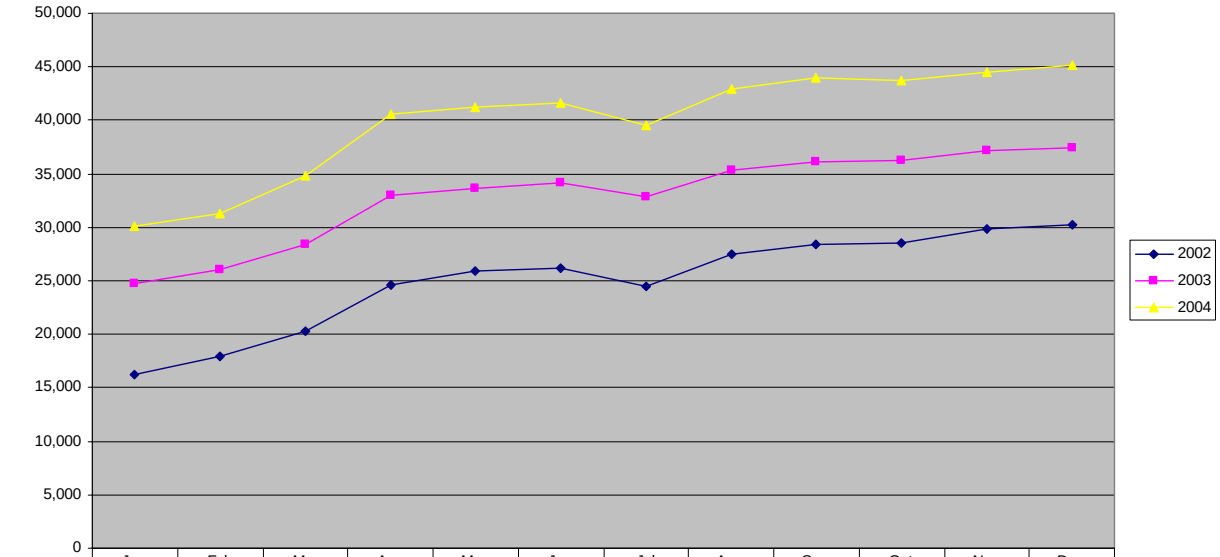
It is important to note that AEI Market Indicator Data is based on nationality, not country of student departure. For example, if a Chinese national resident in New Zealand enrols in Australia, AEI data records this as an enrolment of a Chinese national. *Note AEI enrolment data is extracted from the PRISMS database which is being updated continually by education providers and by DIMIA.*

Overall, AEI Market Indicator data suggests that growth in Chinese student enrolments slowed over 2004. Enrolment growth over 2003 was 22%. In 2004 it was 18% (with some variation at the sector level). Growth in 2005 is likely to increase as AEI has recorded a strong flow in 'commencements'.
Note: 'commencements' is a market indicator of students paying for a new/separate course not physical number of new students.

1.2.1 Statistical data

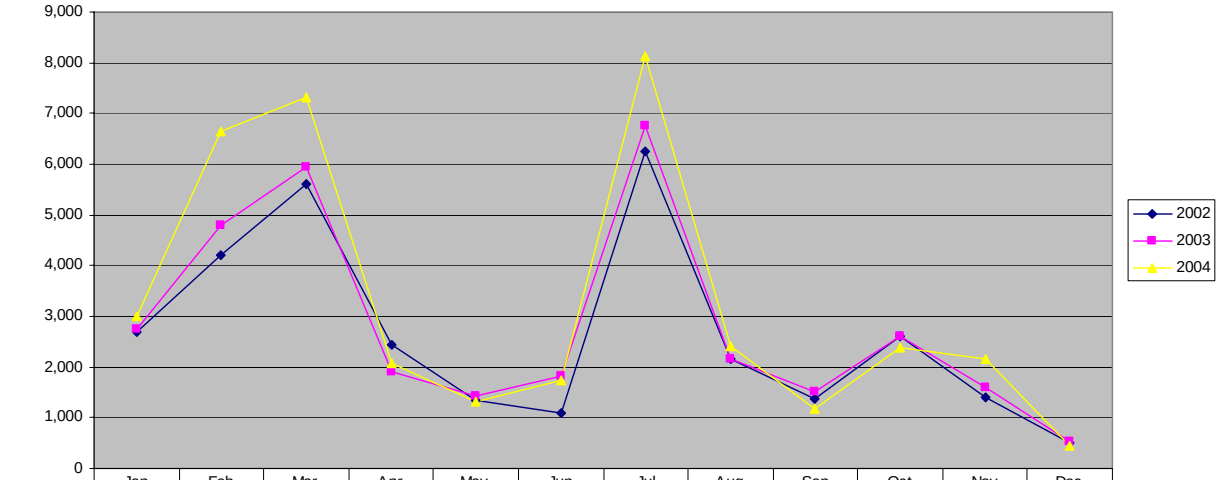
Chinese Enrolments – All Sectors

[NOTE: data for all tables is recorded as at first of each month.]



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	16241	17942	20288	24602	25878	26189	24504	27537	28340	28506	29831	30187
2003	24782	25991	28365	32958	33648	34165	32862	35330	36170	36212	37198	37381
2004	30048	31314	34836	40620	41192	41582	39590	42902	44040	43657	44532	45197

Chinese Commencements – All Sectors

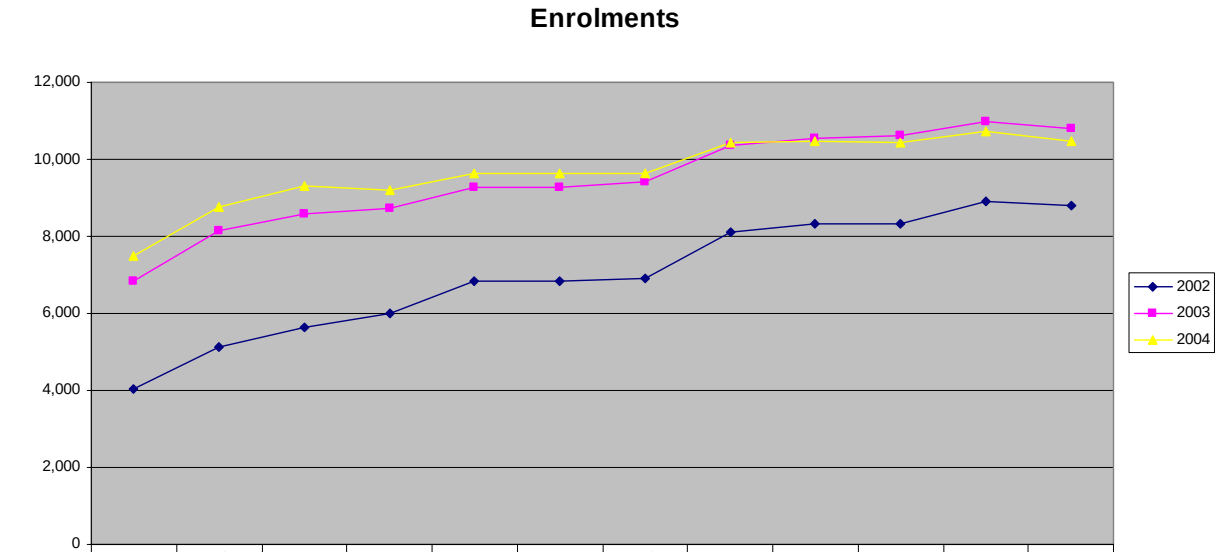


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	2702	4201	5600	2438	1338	1107	6257	2151	1373	2595	1389	512
2003	2735	4797	5938	1902	1422	1824	6757	2153	1515	2595	1611	543
2004	3004	6648	7327	2078	1314	1729	8135	2403	1191	2387	2147	446

Individual Sectors

At the sector level it is clear that the Schools and ELICOS sectors are softening. Actual declines were recorded from September 2004 for Schools and for most of the year for ELICOS. ELICOS enrolments improved at the very end of 2004.

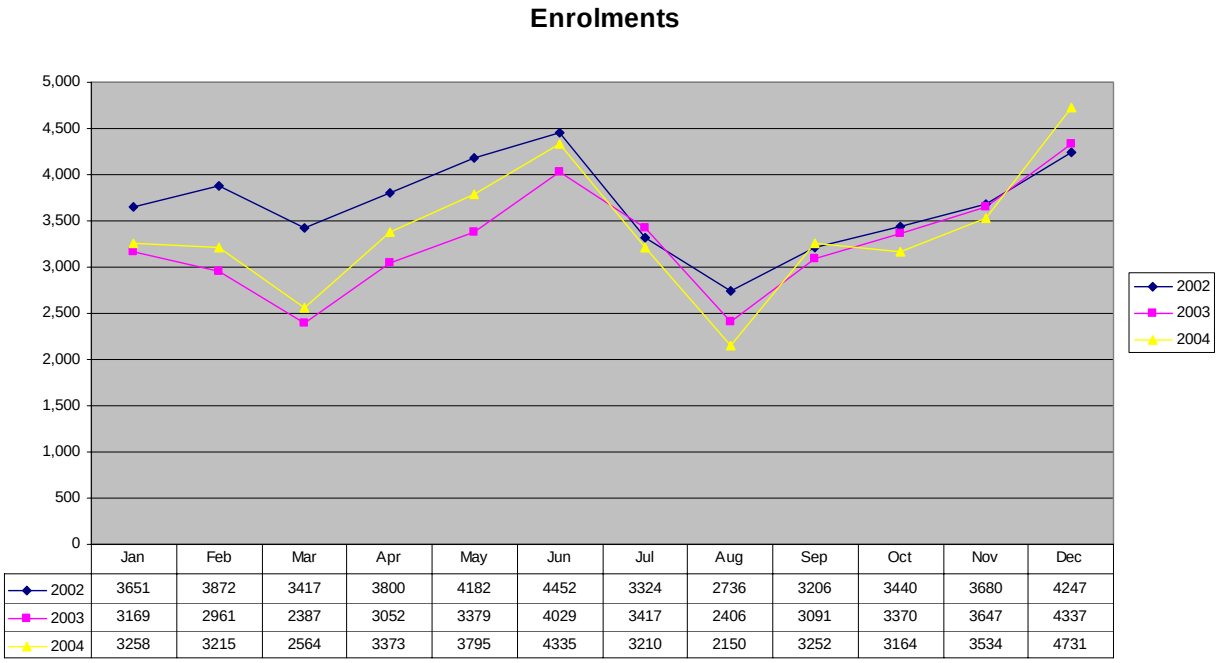
Schools



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	4019	5117	5636	5986	6820	6854	6917	8097	8313	8324	8918	8808
2003	6822	8139	8570	8743	9275	9289	9434	10380	10536	10626	10971	10788
2004	7482	8762	9310	9192	9636	9623	9648	10437	10486	10450	10744	10465

The schools sector is expected to decline further based on the current trend.

ELICOS



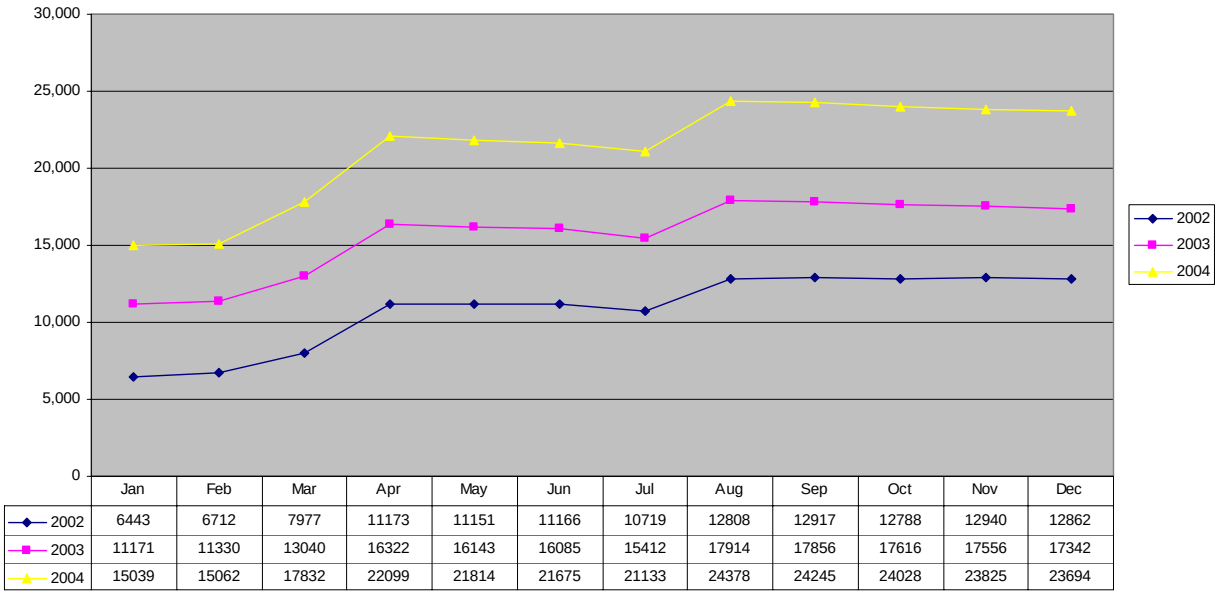
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	3651	3872	3417	3800	4182	4452	3324	2736	3206	3440	3680	4247
2003	3169	2961	2387	3052	3379	4029	3417	2406	3091	3370	3647	4337
2004	3258	3215	2564	3373	3795	4335	3210	2150	3252	3164	3534	4731

AEI expects that the ELICOS sector will improve only slightly (if at all) in the first half of 2005 based on commencements and enquiries.

Higher Education and VET

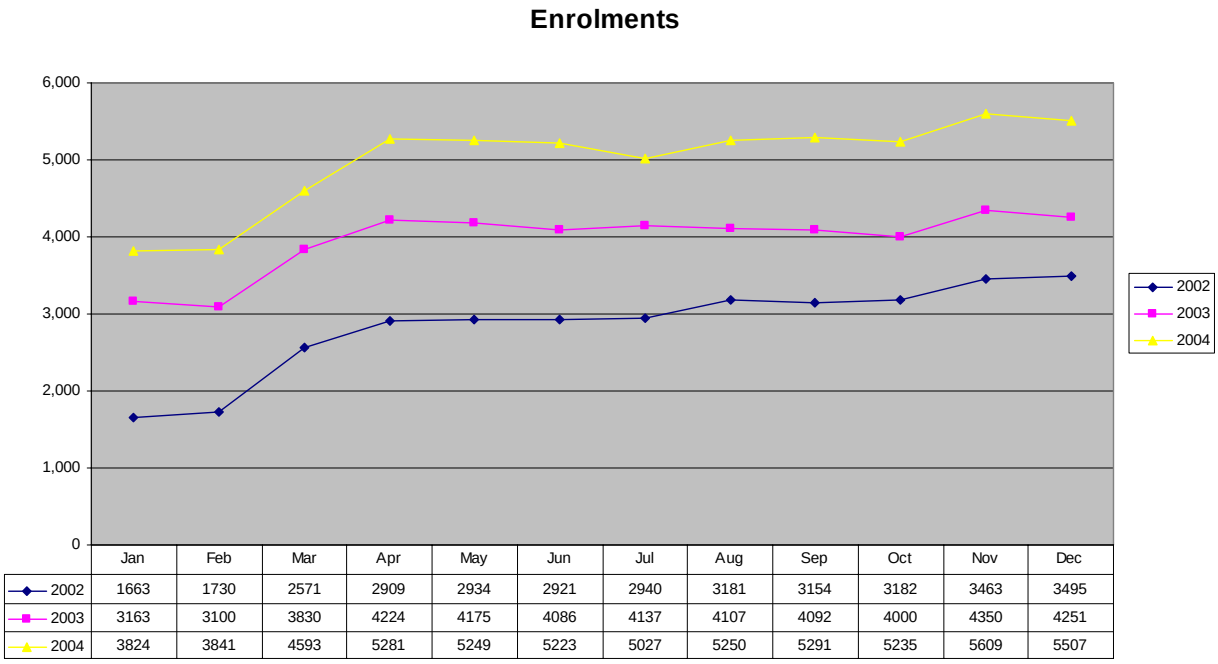
It is possible that good growth will occur in these two sectors but not necessarily at the over 30% rate experienced in 2004.

Higher education



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	6443	6712	7977	11173	11151	11166	10719	12808	12917	12788	12940	12862
2003	11171	11330	13040	16322	16143	16085	15412	17914	17856	17616	17556	17342
2004	15039	15062	17832	22099	21814	21675	21133	24378	24245	24028	23825	23694

Vocational Education



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	1663	1730	2571	2909	2934	2921	2940	3181	3154	3182	3463	3495
2003	3163	3100	3830	4224	4175	4086	4137	4107	4092	4000	4350	4251
2004	3824	3841	4593	5281	5249	5223	5027	5250	5291	5235	5609	5507

1.2.2 Student Welfare Issues

DEST has worked closely with DIMIA to identify emerging student welfare concerns and to address these through early intervention with providers and/or by targeted information sessions on the obligations and responsibilities of providers and students. DEST continues to liaise with the Chinese Embassy, Consulates and the Chinese Ministry of Education to discuss issues relating to student welfare and experience in Australia. Student Welfare Reference Groups involving relevant government agencies, providers, students and community and industry representatives have been meeting in four states since early 2004, sharing information and concerns, liaising with police and welfare agencies, and seeking examples of 'best practice' which can be disseminated more broadly throughout the industry.

The Education Services for Overseas Student Act (ESOS Act) specifically places obligations on providers in relation to student support services for overseas students to ensure that students achieve their study objectives, extending beyond visa integrity issues to encompass the whole education experience. The evaluation of the ESOS Act which is currently underway provides an opportunity to further consider issues relating to the life and study experiences of overseas students in Australia.

1.3 IN-COUNTRY (CHINA) COURSE DEVELOPMENT AND DELIVERY

The appeal of an international qualification combined with limited access to domestic higher education institutions have led to a massive expansion of foreign joint programs in China. Australia is at the forefront of foreign program delivery in China. An estimated 30 000 Chinese students are now studying at Sino-Australian joint ventures in China. These joint ventures cover all levels of education from English

language through to school, VET, undergraduate and postgraduate programs. A high proportion are at VET Diploma level and have been established with a view to broadening recruitment channels. Many of the students enrolled in these courses see them as a pathway to an Australian degree, to be competed in Australia.

The development of the VET sector is a Chinese government priority. As university entrance is highly competitive and the number of places limited, there is a huge demand for technical and further education. Skill-focussed vocational education programs are of particular interest to the government and joint ventures in these areas are particularly welcomed.

Diploma and certificate programs awarded in China require the approval of the provincial education commission only. However, all joint degree programs in China require approval from the Office of the Academic Degree Committee under the State Council. Of the 164 courses approved at June 2004, 48 are with Australian institutions (34 Masters and 14 Bachelors). AEI China advises all Australian universities to ensure that joint degree programs are properly authorised. Full completion of the course in China with conferral of the degree in Australia is considered to be a breach of the law.

Over 20 Australian universities have an offshore presence in China, running a wide range of programs that mostly involve campus-based teaching. Australian universities lead in the provision of approved joint degree programs in China.

Australian vocational education and training providers also have a strong presence in China. For example, TAFE NSW operates joint ventures in Business, English and Information Technology in three locations across China and private sector VET joint programs are also in operation and could be expected to yield significant student numbers also.

The Schools sector is also increasingly engaged in the offshore market: this includes four Queensland schools operating the Queensland syllabus in China; the Tasmanian senior secondary certificate delivered through a cooperative program with a private school group in several cities; and a number of private Victorian schools delivering the Victorian Certificate of Education; and the South Australian Matriculation program (SAM) was launched in 2004.

China is far from a homogeneous market – Shanghai is fast becoming one of the most affluent cities in Asia and by 2012 will have a population of at least 20 million and per-capita GDP of US$10-20 000. In contrast, about half of China's 1.3 billion population lives on less that US$2 per day. Mean GDP per-capita should reach US$1500 by 2012 and the 'middle class' that can afford overseas study should number well over 100 million. Demand for foreign education services will be very closely linked to income levels, and most current programs are in the richer Eastern coastal cities. Australian providers have already established programs in central and Western regional cities (incomes are lower, but foreign competition is less intense). Opportunities will emerge throughout China, but the range of opportunities will be different in the various regions, depending on income levels, impact of economic reforms (more severe in those 'rustbelt' Provinces that are dependent on inefficient State Owned Enterprises), available local education opportunities and Provincial Government policies towards international education providers.

1.4 BARRIERS TO THE CROSS-BORDER PROVISION OF EDUCATION

Australia faces a number of barriers to increasing trade in education services with China, including stiff competition for access to the Chinese education and training market from countries that include the USA, UK, Canada, New Zealand and Ireland, with new competition emerging from EU countries, along with Singapore and Malaysia.

The main barriers to trade in education and training with China that AEI identified as part of research undertaken in 2002 and in consultations with industry are summarised across the four modes of supply below.

DEST has been working to try to ease a number of these barriers through processes such as the World Trade Organisation, General Agreement on Trade in Services. DEST notes that as some barriers in the education services sector can be perceived as 'legitimate' government policy, quality control or consumer protection mechanisms, it is unrealistic to expect the elimination of all barriers for the sector.

Consumption Abroad (Example: Chinese students studying in Australia)

The Chinese Government will only allow approved agents to recruit students for foreign education institutions. Furthermore, only Chinese nationals are allowed to operate as agents in China in collaboration with prescribed overseas educational organisations.

Australian education institutions which seek to be represented by agents in China must produce a certificate issued by the education section of Chinese embassy or consulate offices in Australia. Institutions report frequent delays in having certificates issued, with little transparency in decisions to provide such certificates, or otherwise. Recent advice indicates that the Embassy has suspended processing of applications from private schools.

In recent times, the Chinese Ministry has moved to publish lists of overseas institutions which are deemed suitable to recruit Chinese students. Currently the Australian list at http://www.jsj.edu.cn/mingdan/aodaliya.html includes only universities and public VET institutions (TAFEs). The Ministry of Education expresses reservations about listing private institutions (VET and ELICOS), and thus far has rejected requests to link its site to the Commonwealth Register of Institutions and Courses for Overseas Students (CRICOS) - although reference is made to the address of the site, for students seeking information about private VET or ELICOS colleges. No secondary schools are listed on the site, perhaps reflecting the Chinese Government's discouragement of younger students going abroad for study (the preference is to see students complete secondary school - and even a first degree - before going overseas to study, to ensure greater levels of maturity in coping with foreign environments).

A professional qualification or award is only recognised for courses that have been properly approved by the Chinese national government. The Chinese Service Centre for Scholarly Exchange can recognise (or "authenticate") the qualifications of overseas institutions, however some limitations currently apply. For example, Australian degrees awarded through distance study will not be recognised, although the qualifications of Chinese students gained through correspondence and distance learning programs are generally recognised by Australia (eg through AEI-NOOSR). Also, degrees which are gained through twinning programs (ie part study in China, part in Australia) will only be recognised where the period of study in Australia exceeds 12 months.

Furthermore, there is considerable doubt as to whether Australian degrees gained through study in a third country can be authenticated under current arrangements. The only exception currently appears to be Australian degrees gained through study in approved programs in Malaysia.

Commercial Presence (Example: Australian university campus in China)

Australian institutions are among the most active in the establishment of Chinese-foreign cooperative education programs in China.

Foreign providers must have a local partner in order to supply education services. The local partner is the legal entity. Only the local partner is allowed to market courses, with all advertisements requiring registration with the relevant government agency. The fees charged in China for foreign education suppliers are also subject to approval by the Prices Control Bureau. Total foreign ownership of an educational enterprise is not permitted. A joint education institution must have a Chinese citizen as its president or leading member and must have a governing council comprised of not less than 50% Chinese nationals.

An organisation may not seek profit as the objective in running an education institution in China. The recently released Measures for the Regulations on Chinese-Foreign Cooperation in Running Schools, allow foreigners to participate in an educational school that may request a "reasonable profit return". It is hoped the measures will facilitate more straightforward arrangements for the remittance of funds overseas. Indeed, Article 40 states that Chinese-foreign cooperatively-run schools shall abide by the provisions of the State on foreign exchange control in conducting their activities of the receipt and payment of foreign exchange and opening and using foreign exchange accounts. To date, remittance of funds abroad has been one of the most challenging operational issues for Australian institutions offering programs in China.

There are several restrictions on foreign participation in education, precluding involvement in compulsory education (years 1-9); as well as in military, political and religious education. Foreign providers are required to include compulsory subjects in their curriculum, as decreed by the government. All joint degree programs also require approval from the Office of the Academic Degrees Committee (Ministry of Education) which approves institutions that are entitled to grant degrees.

Foreign education institutions can experience difficulty in establishing a representative office in China, and are prohibited from conducting recruitment activities.

Presence of Natural Persons (Example: Visiting lecturers or teachers)

While difficulties have been reported for a foreign academic (“foreign expert”) to obtain a working visa in China, in fact there are three relevant visa categories for foreign academics and teachers to enter China: Visa Z (Working Visa) is issued to foreign experts who come for long-term work in China and their accompanying family members; Visa F (Business Visa) is issued to those who are invited to visit, teach or participate in the exchange of science, technology and culture and stay in China for less than six months; and Visa X (Student Visa) is issued to those who come to China to study or practice as interns for more than six months.

Cross-Border Supply (Example: Education delivered over the internet)

The Chinese Government maintains a firewall to the internet making access a major problem. Regulatory constraints and obscure procedures make it difficult for foreign companies to obtain certification for, or to distribute, software.

As noted above, foreign qualifications gained through distance education will not be recognised or authenticated by China.

1.5 OPPORTUNITIES/FUTURE POTENTIAL FOR COOPERATION IN EDUCATION

The Chinese market has large growth potential for Australian providers of education and training.

Current GDP growth rates in China see per-capita income doubling every ten years. Domestic demand for education and training is increasing as the proportion of Chinese families that can afford international education rises. China is unable to meet their domestic demand for education and the Government is supportive of international education activity which it views as a means to fast-track education development.

While further growth in the on-shore market for Chinese students is anticipated, limited capacity means that Australian providers may increasingly choose off-shore provision. This is also of benefit to China for a number of reasons including improving infrastructure and it is also likely to decrease the instances of ‘brain drain’.

Other potentially important areas of cooperation are research collaboration, student exchange, language training (particularly increased Chinese language skills in Australian students) and vocational education and training exchange.

2. SCIENCE AND TECHNOLOGY COLLABORATION WITH CHINA

2.1 BACKGROUND

2.1.1 Introduction

In its publication *Science, Technology and Industry Outlook 2004* the OECD reported that as OECD member countries emerge from the recent economic slowdown, more than ever they are taking steps to tap science, technology and innovation to achieve economic and societal objectives.
These measures include protecting funding for these areas from budgetary cutbacks, reforming public research organisations, improving indirect support to business R&D, facilitating public/private partnerships and ensuring supplies of human resources for science and technology.
The report highlighted the growth in globalisation of science and innovation, including investment in manufacturing R&D by foreign companies, and the resulting growth in labour productivity and technological spill-over in the host country. It called for policy makers to recognise the benefits of globalisation.
The Australian Government has recognised the nexus between science, technology and innovation and the nation's economic well-being. The *Backing Australia's Ability* package, initiated in 2001 and supplemented in 2004, committed an additional $8.3 billion to science and innovation over the ten years to 2011. It includes $55.5 million over five years to support the International Science Linkages (ISL) Programme. The ISL Programme provides support to assist Australian researchers gain access to international networks and alliances.

2.1.2 DEST Science Group

The Department of Education, Science and Training aims to ensure that Australia has a strong science, research and innovation capacity and is engaged internationally on science, education and training to advance our social development and economic growth. The Department's Science Group works towards achievement of that goal by:

- Strengthening Australia's ability to generate and use new knowledge
- Enhancing research and development in key national priority areas
- Enhancing innovation performance through a strengthened science and technology base
- Developing facilities to safely manage Australia's low and intermediate level radioactive waste
- Strengthening and diversifying national and international linkages and collaboration.

It also has a whole of government advising role, including:

- Servicing the Office of the Chief Scientist and the Prime Minister's Science, Engineering and Innovation Council (PMSEIC), that provides independent advice to the Government
- Chairing the Coordination Committee on Science and Technology (CCST), comprising heads and deputy heads of Australian Government departments and agencies with an interest in science and technology
- Providing support for the Minister's involvement in other Government science and technology-related fora.

Under its international science programme Science Group promotes Australia's engagement in international science and technology by:

- Managing the International Science Linkages Programme
- Negotiating and coordinating bilateral science and technology agreements
- Managing Australian participation in multilateral fora, including:
    - OECD Committee on Science and Technology Policy
    - OECD Global Science Forum

- APEC Industrial and Science and Technology Working Group

- Undertaking research on international science and technology issues.

2.1.3 Science and technology collaboration with China

DEST regards China as a priority partner for bilateral collaboration in science and technology. This is in recognition of the current level of interest in China by Australian research agencies and China's rapid rise as a significant player in global science and innovation.
DEST is the key implementing agency for science and technology cooperation under a number of national agreements with China:

- Treaty on Cooperation in Science and Technology (signed in 1980)
- MOU on Cooperation in Science and Technology (signed in 1989)
- MOU on Establishment of a Special Fund for Scientific and Technological Cooperation (signed in 2000).

DEST's role under the agreements includes:

- Managing Australian participation in a Joint Science and Technology Commission (JSTC), the last meeting of which was held in Shanghai in August 2004 and included key S&T agencies from both countries
- Managing the Australia-China Special Fund for S&T Cooperation to support collaborative projects between researchers in the two countries
- Supporting strategic fora and other initiatives agreed by the JSTC.

A study commissioned by DEST in 2003, estimated that in 2001-02 China accounted for 4% of Australian government expenditure on international science and technology collaboration[1]. This figure, however, does not reflect either the current level of collaborative activity occurring with that country or the prospects for future collaboration.
DEST's programme of engagement with China is implemented in consultation with other key science and technology organisations, including CSIRO, the Australian Research Council (ARC), Australian Centre for International Agricultural Research (ACIAR), Australian Vice-Chancellors' Committee, National Health and Medical Research Council, Australian Academy of Science, Academy of Technological and Engineering Sciences and the Department of Industry, Tourism and Resources. Each of these has its own active relationship with China.
CSIRO has a wide range of interactions with China, including projects in agriculture and agribusiness, environment and natural resources, radioastronomy, manufacturing and construction, and minerals and energy. China is an important bilateral partner for CSIRO ranking 8th in the number of international interactions.
The ARC promotes international links with innovation systems. Its National Competitive Grants Program funds collaborative projects with Chinese researchers and Chinese industry partners. The ARC has an MOU with the National Natural Science Foundation of China and has exchanged high level visits with them.
ACIAR jointly funds development projects in China with key Chinese funding and research agencies. Its programme focuses on sustainability aspects of agricultural production in the areas of water, land and forest resource management.

2.1.4 DEST's bilateral partners in China

The Chinese Ministry of Science and Technology (MOST) is our key bilateral partner in China. It has an overarching responsibility for international science cooperation, including that which is undertaken by the various science agencies in China. It coordinates Chinese involvement in the JSTC with Australia and initiatives agreed by that body, including the Australia-China Special

[1] Allen Consulting Group 2003 page 21

Fund. It also provides guidance to science counsellors located in China's embassies and consulates throughout the world[2].
The National Natural Science Foundation of China (NSFC) manages the National Natural Science Fund, which supports basic research and talent training[3]. Over the past decade, its charter has been to establish and manage competitive processes for supporting excellent innovative research[4]. It manages its own international collaborative relationships, including agreements with 35 foreign institutions (including the Australian Research Council), academic exchanges, bilateral academic workshops, conferences and joint research projects[5]. The NSFC is an active participant in JSTC meetings, and together with MOST, selects and funds Chinese researchers for the Special Fund grants.
The Chinese Academy of Sciences, which was founded in 1949, has a comprehensive role. It provides policy advice to the Government, is China's highest academic institution, operates a national network of research institutions and universities, and has set up more than 430 S&T enterprises, eight of which are listed on the stock exchange[6]. CAS is an active member of the JSTC and has links with many Australian S&T agencies and the Australian Academy of Science (AAS) and the Academy of Technological and Engineering Sciences (ATSE).

2.2 CHINA'S EMERGENCE IN GLOBAL SCIENCE AND TECHNOLOGY

China's emergence as a world player in science and technology over the last decade has been spectacular. Much has been written about its drive towards technological and economic supremacy.

In 2004 the OECD reported a shift in the relative levels of S&T activity between OECD member countries and non-member countries, and a growing awareness by member countries of competition from non-OECD countries such as China[7]. It reported that:

> *"China's R&D intensity doubled between 1996 and 2002 (from 0.6% to 1.2% of GDP) and its total R&D investments lag those of only the United States and Japan in absolute terms. Foreign R&D investments in China have grown rapidly as the nation's technological capabilities have increased and its markets become more open. US investments alone in China grew from USD 7 million to USD 500 million between 1994 and 2000."*

The OECD also drew attention to the rising incidence of outsourcing of highly skilled jobs by developed countries, particularly to China and India. International outsourcing has been a feature of globalisation in OECD countries for many years, but only recently has it affected highly skilled jobs. China offers a rapidly expanding supply of cheap educated labour, which is in chronic short supply in the developed countries[8].
A report published in 2004 by Professor Jon Sigurdson, a senior research fellow at the East Asia Institute in Singapore, argued that China perceives a narrow window of opportunity to achieve economic pre-eminence through science and technology, before it is beset by the high costs of supporting its rapidly ageing population[9].

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[2] MOST 2003(1) p.11

[3] NSFC 2004

[4] NSFC booklet p.1

[5] NSFC 2004

[6] CAS 2003 p.8

[7] OECD 2004(1) p.11 and p.18

[8] OECD 2004(1) p.146

[9] Sigurdson 2004 p.6

The US National Science Board's publication *Science and Engineering Indicators 2004* rated China highly on a number of indicators, including technological infrastructure, on which it ranked China equal first with Israel amongst transitioning and developing economies[10]. This indicator reflects the extent to which social and economic institutions contribute directly to a nation's ability to develop, produce and market new technology. It takes account of whether the country has a system for protection of intellectual property rights, the extent to which R&D activities relate to industrial application, competence in high-technology manufacturing and capability to produce qualified scientists and engineers. The report also ranked Chinese inventors highly amongst foreign sources of patent applications in the US.

The following is a summary of key data relating to China's emergence in global science and technology. Further detail on these indicators is provided at Attachment 1.

- China's expenditure on S&T has increased both in money terms and as a proportion of GDP. According to the OECD:
  - In 2002 China spent US$72b on R&D, third only to the US (US$277b) and Japan (US$107b)
  - China's investment in R&D rose from 0.60% of GDP in 1995 to 1.23% in 2002, compared to the relatively small increases in the US (2.51% in 1995 to 2.67% in 2002) and Australia (1.58% in 1994 to 1.62% in 2002) [11].
- China is investing heavily in higher education:
  - New enrolments in higher education grew from 1 million in 1998 to 3.2 million in 2003, bringing total number of students enrolled to 9 million
  - More that one third of university students are studying engineering, and together science and engineering account for almost 40%
  - Postgraduate enrolments rose from 10,000 in 1978 to more than 200,000 in 2002 (bringing the total number of postgraduate students to 500,000).
- Contrary to the global downward trend, foreign direct investment (FDI) in China rose from US$40b in 2000 to US$60b in 2004.
- In 2001 China employed 3.141m S&T personnel (including 207.2m scientists and engineers) and 957,000 full time equivalent R&D personnel (including 743,000 scientists and engineers).
- In 2001 China accounted for 4.38% of scientific papers collected by the CSI, EI and ISTP citation search systems, compared to 2.08% in 1994. This took its overall world ranking on the three indexes from 10th to 6th in that period. On the EI in particular, which measures engineering papers, China ranked 3rd in 2000 after the US and Japan.
- The total number of patent families held by Chinese inventors rose from 12 in 1991 to 93 in 2001, which placed it ahead of a many smaller OECD countries.

[10] US NSB 2004 ch.6

[11] In a 2004 presentation to the JSTC, the Ministry of Science and Technology reported that total expenditure had risen to US$80b or 1.32% of GDP

2.3 THE FUTURE FOR COLLABORATION

2.3.1 Measures to strengthen relationship with China

DEST's program of collaboration with China aims to raise Australia's international profile in science and technology and to engender goodwill between the parties. Collaborative initiatives managed by DEST include:

- The Joint Science and Technology Commission, which provides a forum for high level dialogue between key S&T policy makers, research agencies and funding agencies in both countries. The JSTC meets triennially, however, at the last meeting in Shanghai in August 2004, it was agreed in-principle that the next meeting take place in Australia in 2005. The value of the JSTC lies in its ability to provide high level imprimatur to collaboration, to open doors for Australian agencies to relevant Chinese authorities and to overcome cultural barriers to transacting business with a foreign country.
- The International Science Linkages (ISL) Programme, funded by DEST, aims to increase the uptake of leading edge S&T through:
    - Promoting access to and participation by Australian researchers in strategically focussed, leading edge, international scientific research and technology
    - Increased strategic alliances between Australian and overseas researchers
    - Funding for collaboration with China is available under the ISL Programme, particularly from the following funds:
        - The Australia-China Special Fund for S&T Cooperation, under which China and Australia jointly select and fund collaborative projects in agreed priority areas. Australia contributes $500,000 to this fund annually
        - Strategic Policy funds, which are used to support initiatives agreed by the JSTC, including bilateral fora.
- A number of proposals agreed at the last JSTC meeting, and developed in consultation with Australian S&T agencies, are being discussed with China, including:
    - Establishment of a science leaders exchange scheme between future leaders in key S&T organisations in both countries. It's purpose will be to improve mutual understanding of each other's systems and establish important links between institutions
    - A joint web site hosted by DEST and the Chinese Ministry of Science and Technology. This will give prominence to existing collaborations and provide information on sources of funding for prospective collaborators
    - An exploration of opportunities for collaboration in priority areas identified at the last JSTC. This will involve the key agencies in both countries.
- A series of annual symposia between the Chinese Academy of Sciences and its Australian counterparts, the Australian Academy of Science (AAS) and the Academy of Technological and Engineering Sciences (ATSE). This series was initiated at the suggestion of Professor Lu Yongxiang, President of CAS, when he met with Minister Nelson in 2003. The first in the series was held in Melbourne in October 2004 with ISL funding. It involved four concurrent workshops on topics related to sustainability. It brought together leading experts from both countries to discuss and develop proposals for collaborative projects in the thematic areas. China has agreed in-principle to host the next one, possibly in 2005.

DEST supports a network of Education, Science and Training Counsellors in key Australian Embassies and consulates around the world, including Beijing and Shanghai. The Counsellors provide an invaluable service in maintaining contact with Chinese authorities and providing advice to DEST on Chinese S&T issues. Likewise, the Chinese Embassy in Canberra has dedicated S&T personnel, including an S&T Counsellor. This assists us in maintaining a high profile for Australian S&T.

DEST provides competitive funding to the network of Cooperative Research Centres throughout Australia. Many of the CRCs actively pursue collaboration with foreign S&T organisations. In 2004, CRCs reported links with 59 Chinese institutions[12].
DEST also participates in regular high level visits between the two countries, which serve to cement the bilateral relationship at a high level. Important visits in 2003 included Minister Nelson's visit to China, and visits to Australia by Dr Wu Zhongze, Chinese Vice-Minister for S&T and Professor Lu Yongxiang, President of CAS. A visit to Australia is planned for 2005 by Professor Xu Guanhua, Chinese Minister for S&T.

Stakeholder agencies

DEST actively encourages a united approach to international collaboration by Australian S&T agencies. It does this through regular liaison on S&T policy issues and by coordinating Australian participation in JSTC meetings. Stakeholder agencies play an important role in preparing the Australian contribution prior to meetings and in implementing outcomes from the meetings. Organisations involved in the China JSTC include CSIRO, Australian Research Council, Australian Centre for International Agricultural Research, Australian Vice-Chancellors' Committee, National Health and Medical Research Council, Australian Academy of Science, Academy of Technological and Engineering Sciences and the Department of Industry, Tourism and Resources.

2.3.2 Opportunities for collaboration

China's S&T prospects

China's Minister for S&T, Professor Xu Guanhua, reported to the Party Central Committee in 2002, that China's achievements included liberating science and technology as primary productive forces, combining science with economy and knowledge with capital, allowing the market greater prominence in the allocation of resources, and harnessing innovative personnel[13].
China's determination to succeed and the sheer weight of its S&T effort offer excellent opportunities to Australian researchers.
Since the mid-eighties China has undertaken a massive reform program to integrate its national science and innovation system into the economy as a whole, including the restructure of research institutes under government agencies into industrial enterprises.

China has also launched strategic national programs in a number of high technology and new technology areas, including high performance computing, biotechnology and nanotechnology. They have established 53 high technology parks, which account for a high proportion of national high technology output, including exports[14].

In the rapidly expanding electronics sector, China is aiming to establish its own technological platform, and to establish or influence global standards[15].

[12] DEST 2004(2) CRC database

[13] People's Daily Online 20/10/02

[14] In a presentation to DEST in 2004, the Ministry of Science and Technology estimated that output by the national high parks had risen to US$220b, a 30% increase over the preceding year, and that high technology product export increased by 62.7%.

[15] Sigurdson 2004 p.12

Members of the Chinese Academy of Sciences and the Chinese Academy of Engineering were invited to vote for the ten top Chinese science news items for 2004. The results illustrate the achievements of China in new technologies[16]:

- High performance super server
- First Chinese-made nuclear power plant
- Gas pipeline from West to East China
- Next generation internet
- Launch of the second space exploration satellite
- New nanotechnology material
- Underwater high-precision position system
- Discovery of membrane crystal structure
- Quantum telecommunications technology
- Oil and gas exploration in the China Seas.

To complement its focus on new technologies, China is planning to more than double the proportion of its science budget spent on basic research to 20% in the next 15-20 years (from 9% in 2003)[17].

According to the OECD, the Chinese Government is pursuing a market-oriented approach by supporting private business R&D and innovation, commercialising R&D institutes, developing a regional innovation system and encouraging the return of overseas Chinese graduates[18]. Support to private R&D and innovation has included:

- Tax incentives
- Priority to projects involving industry
- Establishment of a Small and Medium Science and Technology Business Innovation Fund
- Establishment of venture capital mechanisms and clarification of foreign investment rules
- Reform of R&D institutes to enhance innovative capacity
- Introduction of regional innovation systems to strengthen cooperation and networking among innovation institutes
- Construction of industrial parks for overseas Chinese graduates and expansion of communication channels between inland and overseas students.

In 2003 China commenced the National Long and Medium Term S&T Development Planning process. It included consultations chaired by Premier Wen Jiabao, and involving senior Ministers and Vice Ministers and more than 2,000 scientists. The result will be a plan to 2020 due to be completed in 2005. The discussions have identified the need to give priority to the following areas[19]:

- Energy, water and environment
- Agriculture, biotechnology, basic research and public health
- International cooperation in S&T.

[16] Xinhua News Agency 14/01/05

[17] Science Development Network 11/01/05

[18] OECD 2004(1) p.71

[19] MOST presentation to JSTC in 2004

China's international S&T collaboration

Part of the Chinese Government's reform strategy has been the opening up of its national innovation system to the outside world. All of the key national agencies include a branch responsible for international cooperation.
China has the following bilateral collaborative programs[20]:

- S&T agreements with 150 countries or regions
- Joint S&T collaboration funds with Australia, the UK, the Netherlands and Israel
- Joint science parks and incubators in the US, the UK, Russia, Singapore and the Netherlands
- Joint research centres with Germany, Spain and the UK.

Australia's other key bilateral partners are increasingly active in China, including the US, Japan and the EU. This greatly enhances international networks for Australian researchers in China.
In the Science Citation Index for 2001, the number of internationally collaborated papers with a Chinese first author was 3,696, a threefold increase over 1995[21]. The CSI also found that:

- Foreign researchers collaborating on those papers came from 81 countries
- Only seven countries accounted for 80% of the collaborations
- As a collaborator with China, Australia ranked 6th behind the US, Hong Kong, Japan, Germany and the UK.

China is participating in the following major international projects[22]:

- EU Galileo Project
- International Thermo-nuclear Experimental Reactor
- Human Liver Proteome Project
- EU Framework Programmes.

China's participation in multilateral fora

China is not a member of the OECD, but it has observer status on a number of its subordinate bodies, including the OECD Committee for Science and Technology Policy (CSTP). The CSTP encourages exchange of information on science, technology and innovation policy. China has been active in the CSTP working group on Technology and Innovation Policy on issues such as intellectual property rights, human resources and national innovation systems.
China is a member of APEC and its subordinate bodies, such as the Industrial Science and Technology Working Group (ISTWG). China has expressed a commitment to bringing about concrete outcomes from that group.
China is also a member of the Asia-Europe Meeting (ASEM), which includes state leaders from both Asia and Europe, the World Health Organisation (WHO) and the World Intellectual Property Organization (WIPO).

[20] Ibid

[21] MOST 2003(2) p.120

[22] MOST presentation to JSTC in 2004

3. QUESTACON

Questacon has had a longstanding relationship with its counterpart organisation in China - the China Science and Technology Museum (CSTM) in Beijing - which opened as a national centre in 1988, the same year as Questacon opened as a national institution. There have been several delegations exchanged in recent years between our respective institutions. CSTM is planning to move to a new, bigger site as part of the Beijing Olympic Site development, and Questacon has been asked for assistance with ideas for exhibition development, etc.

Questacon is coordinating a new three year APEC project to study the beneficial impacts made by science centres and museums on their communities, and to collate and share best practice and innovative programs in this sector. CSTM has registered as a participating institution in this project. This project is also receiving input and support from the China Association of Science and Technology (CAST).

Questacon is providing the exhibitions "Science on the Move" and "Fascinating Science" for display at the Shanghai Science Festival in March 2005. This is the first of Questacon's travelling exhibitions to be hosted by mainland China (previous exhibitions have been hosted by Hong Kong, China).

Questacon provides the secretariat for the Asia Pacific Network of Science and Technology Centres. The Director General of CSTM is a member of the Executive Council of this network, thereby providing additional opportunities for cooperation and networking between our two institutions. CSTM hosted an ASPAC Conference in 1998, and Questacon participated in this event.

Questacon has, in 2003 and 2004, played a keynote role in two symposia organised by the Beijing Association of Science and Technology.

Questacon has proposed two papers as part of the PCST (Public Communication of Science & Technology) Working Conference, being hosted by CAST in Beijing, 10-12 June 2005. Questacon is planning to send at least one delegate to present these papers.

ATTACHMENT 1: KEY INDICATORS FOR CHINESE SCIENCE AND TECHNOLOGY

Investment in research and development

- Research and development in China has enjoyed a large injection of funds in the last decade, bringing it into third place behind the US and Japan on total expenditure.
  - In 2002 the US spent US$277b, Japan US$107b and China US$72b[23].
- As a proportion of GDP, China's investment in R&D has doubled from 0.60% in 1995 to 1.23% in 2002, compared to the lower but more matured increases in:
  - US (from 2.51% in 1995 to 2.67% in 2002)[24]
  - Australia (from 1.58% in 1994 to 1.62% in 2002)[25].
- In 2004 the US National Science Board rated China highly on a number of S&T indicators, including[26]:
  - Technological infrastructure - the social and economic institutions that contribute directly to a nation's ability to develop, produce, and market new technology (includes existence of a system for the protection of intellectual property rights, extent to which R&D activities relate to industrial application, competency in high-technology manufacturing, and the capability to produce qualified scientists and engineers) – China and Israel ranked first amongst the transitioning and developing economies
  - National orientation - evidence that a nation is taking action to become technologically competitive, as indicated by explicit or implicit national strategies involving cooperation between the public and private sectors
  - Productive capacity - the physical and human resources devoted to manufacturing products and the efficiency with which those resources are used (includes current level of high-technology production, quality and productivity of the labour force, presence of skilled labour, and existence of innovative management practices).

Investment in higher education

- Chinese enrolments in higher education, particularly in engineering and science, are booming[27]:
  - New enrolments in higher education grew from 1 million in 1998 to 3.2 million in 2003, bringing total students enrolled to 9 million
  - More that one third of university students are studying engineering, and together science and engineering account for almost 40%
  - Postgraduate enrolments rose from 10,000 in 1978 to more than 200,000 in 2002 (bringing the total number of postgraduate students to 500,000)
  - 125,000 Chinese postgraduate students (or more than one fifth of the total) were enrolled in overseas universities in 2002.
- China has boosted output of PhDs in science and engineering by 14% a year, while the number of US graduates fell[28].

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[23] OECD 2004(2) p.18 & p.57

[24] OECD 2004(1) p.191

[25] DEST 2004(1) p.5

[26] US NSB 2004 ch.6

[27] Sigurdson 2004 p.14

[28] Garten 2005 p.20

- American universities award 25% of all PhDs in science and engineering to Chinese citizens and China is taking steps to attract them back to China[29].

Exports

- The level of technology-intensive exports from China rose, while they fell in the US[30].
- Chinese companies, especially in the electronics sector, are emerging as significant multinational corporations[31].
- China is experiencing a boom in both its domestic and export markets[32].

Foreign investment

- Foreign companies are increasingly establishing large R&D facilities in China[33,34.] Nine major Japanese companies have established 200 new enterprises in China since 2001[35].
- Foreign direct investment (FDI) in China is going against the global trend[36]:
  - Global FDI dropped from US$1,388b in 2000 to US$560b in 2003
  - FDI in China grew from US$40b in 2000 to US$60b in 2004
- US investments in China grew from US$7m in 1994 to US$500m in 2000[37].
- The motives for foreign companies setting up in China are threefold: namely to gain access to relatively cheap, educated labour, to gain access to the burgeoning domestic market[38] and to benefit from the stable and increasingly transparent investment environment in China[39].

Personnel

- China records data on both its S&T and R&D personnel populations[40]. In 2001 it recorded:
  - 3.141m S&T personnel (37% higher than 1991), including 207.2m scientists and engineers
  - 957,000 FTE R&D personnel (43% higher than 1991), including 743,000 scientists and engineers.
- Despite the large numbers, however, China's total researchers FTE per thousand total employment was only 1.4 in 2002 and 1.2 in 1999, compared to:
  - 7.2% in Australia (2000)
  - 8.6% in the US (1999).

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[29] Ibid

[30] Ibid

[31] Sigurdson 2004 p.2

[32] Sigurdson 2004 p.3

[33] Garten 2005 p.20

[34] Sigurdson 2004 p. 2

[35] Asia Times Online 15/02/05

[36] Ibid

[37] OECD 2004(1) p.18

[38] China Economic Net 7/2/05

[39] Asia Times Online 15/02/05

[40] MOST 2003(2) ch.1 In this context, S&T is defined as an organised activity closely related to the generation, development, diffusion and application of S&T knowledge, while R&D is systematic and creative activity for the purposes of increasing the total amount of knowledge, or creating new applications.

S&T output

Citations

- In 2001 China accounted for 4.38% of scientific papers collected by the CSI, EI and ISTP citation search systems, compared to 2.08% in 1994. This took its overall world ranking from 10th to 6th in that period[41]:
  - On the SCI, which measures basic research papers, in 2001 China ranked 8th and its annual growth rate was 19.2% over the preceding seven years, compared to the world average growth rate of 4.3%
  - On the EI, which measures engineering S&T papers, China ranked third in 2000 after the US and Japan
  - On ISTP, which measures international conference papers, China ranked 6th in 2001.

Patents

- The total number of patent families held by Chinese inventors rose from 12 in 1991 to 93 in 2001, which placed it ahead of a many smaller OECD countries. On a per capita basis, though, it remains low by OECD standards[42].
- The US National Science Board rated Chinese inventors highly amongst foreign sources of patent applications in the US[43].

[41] MOST 2003(2) ch.5 Data is collected by three international bodies on published papers authored by Chinese S&T personnel, namely the Science Citation Index (SCI), Engineering Index (EI) and the Index to Scientific and Technical Proceedings (ISTP).

[42] OECD 2004(1) p.40

[43] US NSB 2004 ch.6

ATTACHMENT 2: REFERENCES

Allen Consulting Group - *A Study of International Science and Technology Policies and Programs*, DEST 2003

Asia Times Online – China Bucks Global Foreign Investment Trend – online article 15 Feb 2005

Chinese Academy of Sciences (CAS) – book on role and activities 2003

China Economic Net – *R&D Centers Flood in to Harness the Chinese Brain* - 7 Feb 2005

Department of Education, Science and Training, Australia (DEST):
2004(1) *Australian Science and Technology at a Glance 2004*
2004(2) CRC database

Garten, Jeffrey – *China's R&D Revolution* – Business Review Weekly 3 Feb 2005 p.20

Ministry of Education, Science and Training, China (MOST):
2003(1) *The Brief of the Ministry of Science and Technology of P.R. China*
2003(2) *China Science and Technology Indicators 2002*
2004 Presentation to Joint Science and Technology Commission meeting, Aug 2004

National Natural Science Foundation of China (NSFC)
Booklet (undated) on role and activities of NSFC
2004 Presentation to Joint Science and Technology Commission meeting, Aug 2004

OECD:
2004(1) *Science, Technology and Industry Outlook 2004*
2004(2) *Main Science and Technology Indicators Vol 2004/1*

People's Online Daily - *Historic Achievements Gained in China's Science and Technology* - online article 20 Oct 2002

Science Development Network – *Funding Boost for Basic Science in China* – online article 11 Jan 2005

Sigurdson, Professor Jon - *China Becoming a Technological Superpower: a Narrow Window of Opportunity* - East Asia Institute Singapore, June 2004

US National Science Board (NSB) – *Science and Engineering Indicators 2004* – National Science Foundation 2004

Xinhua News Agency - *Academicians Vote Top 10 Science News* – online article 14 Jan 2005