

SUMMARY

STRATEGY

KNOWLEDGE-BASED
COLLABORATION BETWEEN
DENMARK AND CHINA

2008

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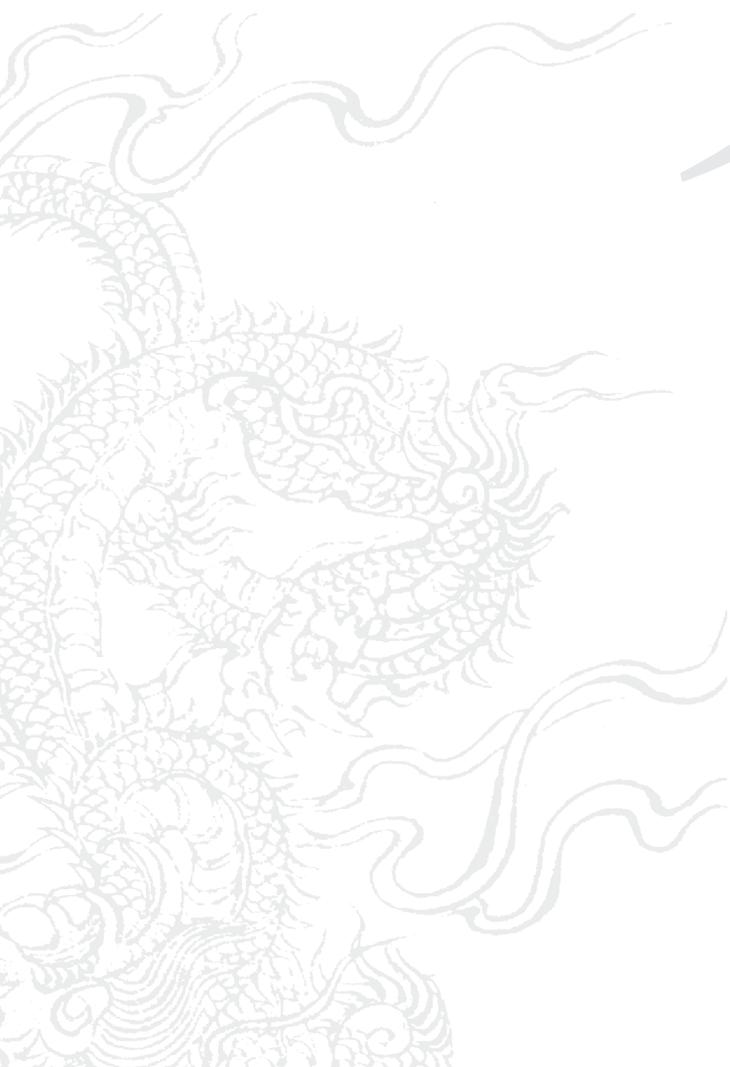


Ministry of Science
Technology and Innovation

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In recent decades, China has gained a position as a principal actor worldwide in terms of knowledge. With its two-digit annual growth rates, massive investments in research and development and several large universities ranked among the best in the world, China is at present in the midst of a fundamental change in the global knowledge circuit. In other words: the central point of knowledge is moving – in the direction of China.

One of the opportunities we must not miss is to keep the door open to enhanced knowledge-based collaboration with China. China is currently determinedly focusing on the development of knowledge and competencies in areas that have been given high priority also by Danish knowledge institutions and industry. Consequently, collaboration with China can create substantial value for the Danish society and contribute towards positioning Denmark in the global knowledge economy.

In order to exchange knowledge and talent with China, Denmark has to be an attractive partner. Hence, we must use the opportunities offered by the fact that Danish researchers and industry are today at the forefront in numerous areas. The perspective is that both Denmark and China stand to gain from enhanced cooperation.

A large number of Danish companies are already represented on the Chinese market, and several Danish universities and research institutions have well-established relationships with their Chinese partners. With the launch of a China strategy Denmark intends to support and enhance the existing collaboration. We will provide the framework together with the Chinese authorities, and it will then be the responsibility of individual universities and companies in Denmark and China to use the framework to conclude concrete agreements on projects and talent exchange.

Signing of memorandum of understanding on bilateral cooperation in science and technology. Danish Minister of Science, Technology and Innovation, Helge Sander, and Chinese Minister of Science and Technology, Wan Gang. Tuesday September 25, 2007 in Beijing.



The strategy is the Ministry of Science, Technology and Innovation's contribution to the Danish Government's action plan for China, which will be launched in the autumn of 2008. The Government's action plan is expected to provide the comprehensive framework for Denmark's collaboration with China, e.g. in education, culture and commerce.

This strategy has been developed in collaboration with the Danish Embassy in Beijing and the Innovation Centre Denmark in China. At the same time, universities and researchers who are well acquainted with the development in China have supplied indispensable contributions to the analyses and initiatives of the strategy. Finally, a number of ministries and central industrial organisations have contributed towards the quality assurance of the strategy.

The launch of the China strategy marks the beginning of the actual work to convert priorities and new initiatives into concrete results. I am looking forward to discussions with the parties in the Danish Parliament on the financing and implementation of the strategy. As the Chinese say: "Action speaks louder than words".

A handwritten signature in black ink, appearing to read 'Helge Sander'.

Helge Sander
Minister for Science,
Technology and Innovation

The full report in Danish is available for download at www.vtu.dk

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INTRODUCTION

China's development will change our view of the world. The Middle Kingdom has in the span of a few decades developed from a backward agricultural society to the world's fourth-strongest economy, and this development is continuing. China is no longer merely the assembly line of the world. The focus on knowledge and education is intense, and China is increasingly asserting itself also in the technological area.

The development in China is often described in connection with other economies that have experienced major growth in the last few decades, such as, for instance, the Asian tiger economies. But it would be a mistake to view China's progress merely as the latest addition to the Asian miracles.

On the contrary, the emergence of China should be compared to the emergence of the United States of America on the world's economic stage at the beginning of the 20th century. These years we witness the modern manifestation of a thousand-year-old cultural realm with unrivalled human resources, powerful dynamism and an extremely high level of ambition. The development in China will have an impact on the entire global economy and has already in several areas contributed to redefining the economic and technological map of the world.

China has displayed its strong dynamism with its objective of increasing the country's scientific and technological capacity. Since 1999 China's research and development costs (R&D) have increased by more than 20% per year, and in December 2006 China reached a position as the country with the second largest R&D investments in the world after the United States. Also in terms of higher education China's growth has been almost astronomical. In 1997 a total of 3.2 million students were matriculated at universities in China. Eight years later this figure has grown to 15.6 million. With its annual output of 5.2 million engineers China produces the highest number of engineering graduates in the world.



... Introduction

Central indicators for China's innovation system

	1997	2001	2005
Total R&D investments (US\$)	6.1	12.5	30.1
R&D investments in % of gross domestic product	0,64 %	0,95 %	1,34 %
Private share of total R&D investments	55 %	56 %	66 %
Number of students enrolled in universities (m)	3,2	7,2	15,6
Researchers (1000 man-years)	559	743	1.119
Patent applications in China	114.208	203.573	476.264
Scientific publications (SCI)	35.311	64.526	153.374
Export of high technology in % of total export	8,9 %	17,5 %	28,6 %

Source: OECD 2007, China Statistical Yearbook 2007 and Jacobsen 2007 (Eds)

It is decisive that Denmark takes an active stance to face this new reality and is able to use the numerous opportunities for trade and collaboration that it offers. As regards higher education, research and innovation we have to expand the collaboration with authorities, knowledge institutions and business enterprises in China. Here, the central concepts are equality and mutual exchange of knowledge, highly educated manpower and technology. Both Denmark and China stand to win a great deal through dialogue and collaboration.

Increased interaction with China in the knowledge area depends on our understanding of where we stand, and what we wish to gain from our collaboration. It is from this angle that the Ministry of Science, Technology and Innovation's China strategy should be seen. The objective is to chart the course and launch new initiatives to strengthen our collaboration with China in the fields of higher education, research and innovation and to create the framework for increased harmonisation and coordination of the Danish effort.

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THE OBJECTIVE AND FOCUS OF THE STRATEGY

The China strategy forms part of the overall implementation of Denmark's strategy for Asia and of the Government's objective to work out action plans for cooperation with China and other countries. With its emphasis on research, innovation and university education, the strategy is aimed at the Ministry of Science, Technology and Innovation's sphere of competence.

The overall vision is that Denmark and China will grow to be close partners in the knowledge area in the coming years. This will lay the groundwork for adding value to the Danish and Chinese societies through exchange of knowledge, technology and highly educated manpower. At the same time, the bilateral cooperation between the countries contributes to increased networking and cultural understanding, with benefits for both Denmark and China in a global context marked by mutual dependence.

The China strategy seeks, in the first place, to support Sino-Danish collaboration with regard to education, research and innovation, both qualitatively and quantitatively. In global competition it is not sufficient to have access to cutting-edge domestic research and technology. Most of the world's aggregate knowledge is produced outside Denmark. Hence, it is important that Danish researchers and business enterprises focus on international research environments and growth areas and have easy access to the knowledge created in the rest of the world.

In the years to come it is expected that a growing part of the world's knowledge production will originate in China. Consequently, Danish researchers and businesses have a clear interest in establishing networks and collaborating with the Chinese, thus contributing to and acquiring part of this knowledge.

Secondly, the China strategy is intended to support the activities of Danish businesses in China. Today, Denmark has many competitive business enterprises that create products with a high added value and with a large potential for the future. Hence, Denmark is well placed for benefiting from



... The objective and focus of the strategy

globalisation and responding to the demand for constant and rapid innovation.

It is a prerequisite for future growth that Danish businesses exploit international collaboration and sales potential and have access to the required manpower. Mobility incentives are expected to increase the number of Danes and Chinese with mutual knowledge of their respective countries. This will improve the basis for the businesses' recruitment of researchers and other highly educated staff.

The objectives of the Ministry of Science, Technology and Innovation's China strategy can be summed up as follows:

- To facilitate the access for Danish universities, business enterprises and institutions to create knowledge and innovation in cooperation with Chinese partners.
- To increase the attraction of Chinese talents to Danish universities, business enterprises and institutions in both China and Denmark.
- To increase Danish researchers' and students' access to and insight into Chinese educational, research and innovative environments.

In order to ensure the best possible use of the resources and professional competencies it is decisive to prioritise this effort in relation to China. Hence, the focus of the strategy is on four different dimensions: areas of collaboration, lines of action, institutions and geography.

As regards areas of collaboration, the implementation of the China strategy is focused on education and research fields where Denmark and China hold a powerful position or have a strong potential. This creates the basis for equal collaboration where both countries stand to win, which is the case in the following areas: environment, clean energy, biomedicine and life sciences, nanotechnology, ICT, agriculture and food.

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The humanities and social sciences also play an important role in the growing interaction between Denmark and China. Danish companies in China need to draw on the best knowledge of the Chinese language, culture and social conditions in order to act optimally on the Chinese market. At the same time China faces major social challenges in areas where Denmark has achieved internationally recognised results. This includes welfare, income distribution policies and corporate management. Also in these areas the potential for developing the mutual collaboration within research and education is huge.

There are already numerous collaborative relationships in all of the above-mentioned areas between Danish and Chinese research and educational institutions. With the conclusion of a number of bilateral research and educational agreements between Denmark and the People's Republic of China in September 2007 and the stationing of Denmark's first research attaché in China at 'Innovation Centre Denmark' in Shanghai yet another significant step has been taken by the Ministry of Science, Technology and Innovation to prioritise collaboration between Denmark and China.

The strategy is also focused on lines of action that are expected to have a large potential in terms of strengthening and expanding knowledge-based collaboration with China. This is the case of certain existing lines of action that the strategy is intended to help to target and render more visible. At the same time a series of new initiatives will be launched, which are expected to contribute significantly to achieving the objectives of the strategy.

As regards the strategy's geographical and institutional focus, the aim is to conclude framework agreements on joint funding and reciprocity with selected institutions that are strongly represented in the growth areas of East China. Within the framework of these agreements it will be up to the individual researchers and knowledge institutions in Denmark to identify relevant collaboration partners. This will support the principle of researcher-driven collaboration based on merging interests.



PRINCIPLES FOR IMPLEMENTATION OF THE STRATEGY

The implementation of the China strategy will aim at observing a number of basic principles.

Maintenance and expansion of cooperation is subject to both parties gaining from it. Hence, the cooperation with China will be focused on reciprocity and respect. Denmark will aim at equal cooperation within areas where both countries are in a strong position and have an interest in exchanging knowledge and resources.

When implementing the strategy another aim will be to increase Denmark's presence in China. Denmark is only really interesting for China when Danish knowledge institutions and innovative businesses are present with an adequate critical mass of visible competencies that are in demand in China. Increasing Denmark's representation in China also makes it easier to follow the development at close range and to make use of the new opportunities for cooperation between Denmark and China that occur continuously.

Experience has shown that in collaborating with China it is important to ensure that the Danish effort is firmly anchored in the political system. The implementation of the strategy will therefore be accompanied by high-level representation, and it will be ensured that Denmark has a clear policy towards China in the knowledge area. At the same time, Denmark will seek to increasingly coordinate and professionalise the Danish effort. Compared to China, Denmark is a small country that will only be able to achieve sufficient visibility and volume through collaboration between different institutions.

Denmark will implement the strategy through existing funding facilities, especially the central government advisory and funding system for research and innovation. Thus the coherence with the national effort in the knowledge area and with other initiatives launched to strengthen international cooperation will be ensured.



The human rights dialogue is an integral part of Denmark's and the EU's cooperation with China, especially with a view to supporting the country's democratic development and securing the protection of minorities. When implementing the strategy it will have to be ensured that the cooperation will respect universal human rights, ethical considerations and the basic principles of freedom of research and scientific method.

The Chinese authorities have for several years been under pressure from the EU and the United States to strengthen its legislation on intellectual property rights and, in particular, the enforcement thereof. The Danish Patent and Trademark Office maintains a close dialogue with the Chinese authorities on the provision of sufficient capacity to enforce intellectual property rights. In connection with the implementation of the strategy the Ministry of Science, Technology and Innovation will support this work by rendering this problem visible to its collaboration partners in China. Ensuring regulation of intellectual property rights when concluding bilateral agreements and launching concrete collaboration projects is the responsibility of the Danish Patent and Trademark Office.

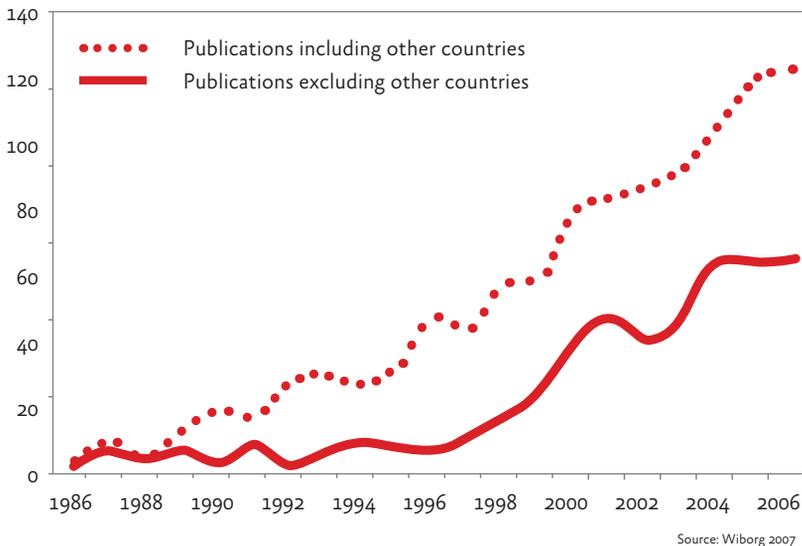
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STRENGTHENED SINO-DANISH COLLABORATION WITH REGARD TO RESEARCH AND INNOVATION

The Sino-Danish research collaboration has wide ramifications in both Denmark's and China's innovation systems. Bibliometric analyses show that the last ten years have seen a huge growth in the number of publications with shared Sino-Danish authorship. Between 1996 and 2006 the number of Sino-Danish joint publications increased by 32% per year. In other words, there is no doubt that both Danish and Chinese researchers estimate that they will benefit from strengthening and expanding their cooperation.

Number of joint publications between Denmark and China in recognised international scientific journals



Since the beginning of the 1980s a large number of Danish companies have established businesses in China. The centre of attention for most Danish companies in China is sale and production. However, the trend is that also for Danish companies it is no longer enough to send well-known Western

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products to China or to set up a simple production. There is a growing demand for an effort that is meticulously adapted to the Chinese market. Consequently, a number of actors have launched both research and development (R&D) directed towards the Chinese market. According to an analysis from the Trade Council of Denmark, 10% of the Danish companies in China have regular R&D activities. In other words, Danish businesses have also seized the many opportunities to expand knowledge-driven collaboration with China.

In addition to targeting the existing lines of action and block grants, the Ministry of Science, Technology and Innovation will contribute to launching a number of new initiatives to support the cooperation within the prioritised areas:

- **Provide support to Danish researchers' stay in China.** It is decisive for Denmark to be able to dispose of a pool of scientists and national competencies in the language and social conditions of China. As China's global importance grows, so will the demand for teachers and researchers with knowledge of the development in China. Hence, the Ministry of Science, Technology and Innovation will seek to make a limited number of scholarships available to Danish social scientists who wish to go to China to teach and/or research in cooperation with professors at a Chinese university.
- **Block grants for Danish universities offering Ph.D. programmes for the purpose of financing the stay of Chinese researchers in Denmark.** The Ministry of Science, Technology and Innovation will seek to offer block grants to Danish universities offering Ph.D. programmes in order to finance – wholly or partly – the stay of Chinese Ph.D. students and post-docs in Denmark. The objective is for Denmark to become an attractive destination with a promising educational and career potential for talented Chinese researchers. The use of block grants rather than individual scholarships is expected to create a good basis for enabling Danish institutions offering Ph.D. programmes to conclude binding collaboration agreements with partners in China with mutual exchange of young researchers. Moreover, this type of subsidy is expected to enable the institutions offering Ph.D. programmes to combine researcher mobility on one hand and staff planning and strategic research objectives on the other.



... Strengthened Sino-Danish collaboration with regard to research and innovation

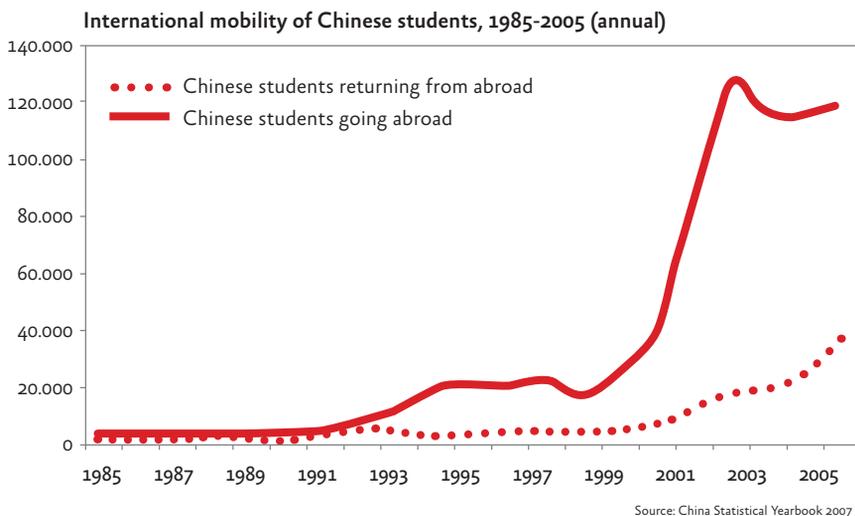
The implementation of this line of action will emphasise the cooperation between the institutions and the Danish business community for the purpose of setting up internships and – where relevant – researching in areas relevant to private enterprises.

- **Block grants to promote networking between strong research and innovation environments in Denmark and China.** Strong relationships between researchers constitute another cornerstone of increased knowledge-driven collaboration between Denmark and China. Research collaboration creates a critical mass of infrastructure and talents and lays the foundation for exchange of knowledge and know-how. The Ministry of Science, Technology and Innovation will seek to provide earmarked subsidies for collaboration, joint professorships and networking between powerful public and private research environments in Denmark and China within prioritised fields. These subsidies will be allocated as block grants to existing groups of researchers and innovation networks in the two countries that are already subsidised as far as the domestic part of their activities is concerned. Thus the funds will be targeted on the costs of the groups' mutual cooperation only, and this will create a good basis for quickly achieving concrete results from their collaboration.
- **Cultivation of new research collaboration initiatives between Denmark and China.** The Ministry of Science, Technology and Innovation will not only focus on enhancing the relationship between strong research environments in Denmark and China, but also on the cultivation and support of new possibilities of bilateral collaboration. Thus it is intended to support smaller-scale initiatives seeking to establish contact and to identify the potential for collaboration between public and private researchers in Denmark and China. Financial support will specifically be granted to thematic workshops, symposia, conferences etc. that facilitate the interaction between researchers in Denmark and China. Apart from discussions on scientific content, joint events could also detail areas for future cooperation. Consequently, the financial support provided should include a moderate amount to be earmarked for follow-up activities (e.g. travel) aimed at formulating concrete collaborative projects, for instance by submitting a project application to the Danish research councils, the Chinese authorities or the European Seventh Framework Programme.

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ENHANCED COLLABORATION WITH CHINA WITH REGARD TO UNIVERSITY EDUCATION

The strong economic growth in China in recent years has increased the demand for further expansion of higher education studies. At the same time the Government's ambition to strengthen China's innovative capacity depends on the availability of a large supply of research-based university programmes. Higher education in Denmark can offer many advantages that are of interest to China. These include Danish universities' long tradition of integrating research and teaching and using pedagogical methods that support the growth of independent and creative individuals. Hence, there will be excellent opportunities in the years to come to expand the collaboration with China with focus on the contents of higher education.





... Enhanced collaboration with China with regard to university education

Since the mid-1990s the Chinese Government has sought to eliminate regulatory hindrances for international student mobility. It is estimated that more than 100,000 Chinese left the country to study abroad during the period 2003 to 2006. Hence, there is a large potential in increasing the mobility of talented young students between Denmark and China. Mobility facilitates cultural insight and the creation of personal contacts and networks that will be a driving force for the future collaboration between Denmark and China with regard to knowledge.

In addition to targeting the existing lines of action and block grants, the Ministry of Science, Technology and Innovation will seek to launch a number of new initiatives to enhance student mobility between Denmark and China and to support the collaboration between Danish universities and Chinese knowledge institutions:

- **Scholarships for the exchange of talented Masters students between Denmark and China.** The Ministry of Science, Technology and Innovation will seek to increase the mobility of students between Denmark and China. A number of scholarships will therefore be offered to talented Chinese students applying for admission to a Masters programme. These scholarships will be provided by expanding the existing scholarship programme for foreign students from outside the EU/EEA (European Economic Area) and should be used within the framework of the established strategic alliances between Danish and Chinese universities.
- **Cooperation with industry to promote student mobility between Denmark and China.** The Ministry of Science, Technology and Innovation will encourage Danish universities and companies to conclude trainee and internship agreements for leading Chinese students with a view to increasing the students' insight into working conditions and job opportunities in Denmark. Similarly, the Ministry will seek to provide an attractive framework for enabling Danish students in China – including students on special elitist programmes – to participate in internships also in Danish companies.



- **Alumni networks for foreign students.** Danish universities should be encouraged to create a network culture, and in that connection the networks should be targeted at comprising former Chinese students from Danish educational institutions and Danish knowledge workers in China. These networks, which may be "alumni-type networks" for foreign students, should ensure subsequent contacts with the institution and fellow students. The networks could, for instance, encourage former exchange students or students from "summer universities" to take a Masters degree at the same university. Moreover, these networks could encourage former students to recommend the university to other students in China.

- **Establishment of a 'Sino-Danish University' in China.** In order to enhance the visibility of Danish research-based advanced education in China the Ministry of Science, Technology and Innovation will, in collaboration with Danish universities, explore the possibilities for establishing a university as a joint venture in China. A 'Sino-Danish University' could function as a visible and accessible platform for interaction with Chinese knowledge institutions and authorities. The university could be organised, for instance, as a joint venture between the eight Danish universities, a Chinese university as well as a number of research institutions and approved technological service institutes. Such collaboration would generate the necessary critical mass while combining the positions of strength of the various institutions. In addition to the actors mentioned, Danish and Chinese industry could make contributions to the university in the form of funding and offer internships and collaboration with regard to the contents of the programmes.

- **Strategic alliances between Danish and Chinese universities.** In coordination with the Chinese Ministry of Education, the Danish Ministry of Science, Technology and Innovation will seek to support the conclusion of binding strategic alliances between Danish and Chinese universities. Formalised collaboration between Danish and Chinese universities can help to make Danish university education visible and provide a good framework for broad collaboration on the contents of the educational programmes, completion of research projects and mutual learning through benchmarking.



THE IMPLEMENTATION OF THE STRATEGY

In order to strengthen and expand the knowledge-driven collaboration with China it is important not only to achieve clarity as to objectives and lines of action, but also to define how the strategy will be anchored from an administrative point of view, and how it will be financed. This will provide the basis for translating words into action.

New initiatives launched in connection with the strategy will as far as possible be implemented through the existing financing instruments and administrative support functions. This will enable economies of scale and the opportunity to coordinate the effort with existing initiatives, both nationally and internationally.

It is expected that the strategy will be financed in 2008 via funds earmarked for international collaboration as part of the block grant for globalisation. The relatively modest means will be targeted at network activities organised in cooperation with the Innovation Centre Denmark in Shanghai.

In the years 2009-12 the lines of action of the strategy will be financed through the establishment of a fund earmarked for bilateral cooperation. Following negotiations with the parties in the Danish Parliament, this appropriation is expected to come out of the unallocated reserve of the globalisation fund for the period 2009-12.

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