


Norwegian business in China: Intentions and impacts

A study of knowledge networks, innovation and
competitive advantage

Report
International





This publication may be ordered at
www.forskningsradet.no/publikasjoner

The Research Council of Norway

P.O. Box 2700 St. Hanshaugen
NO-0131 Oslo

Telephone: +47 22 03 70 00

Telefax: +47 22 03 70 01

post@forskningsradet.no

www.rcn.no/english

Design: Agendum See Design

Photo: Shutterstock

Printing: 07 Gruppen AS

Number printed: 150

Oslo, March 2008

ISBN 978-82-12-02552-3 (printed version)

ISBN 978-82-12-02553-0 (pdf)

挪威在中国商 · 活 · : · 机和影响

- · 于知 · 网 · , · 新与 · 争 · · 的研究

Svend Otto Remoe 撰

Prokontra 咨 · 公司

2008 年 于挪威

前言

中国在政治、经济、文化方面与世界经济一体化的发展已成当今世界全球化的一个明显写照。作为一个经济上升发展的国家，中国将其科研新体系的发展给予更多的关注，这一举措具有重要的全球影响。在过去的几年里，中国科研体系进行了结构性调整，研究所的数量减少了，质量提高了，国际合作受到了鼓励，在国际期刊上发表的论文数量大幅度增加。2006年1月，中国制定了一个新的15年科研发展规划，目的是到2020年进入以知识创新为主体的发展阶段。这意味着，科研投入要从2005年占国民生产总值的1.3%增加到2020年的2.5%。目前，中国名列世界第四经济大国，今后的目的是通过增加科研投入来保持其经济地位的持续增长。

挪威政府首先考虑不断增强的中挪之在科研领域的合作。2007年，政府颁布了新的中国战略，科研领域被作为重要的手段来促进和加强双边的合作。这一新的战略将致力于激发挪方的商业兴趣、知识和价值观念，并将环境、气候变化与可持续发展融入中挪合作的所有领域。

中挪政府之间的科技合作将于今年秋天签署。此外，挪威研究理事会将与不同的中国研究机构签署合作意向书，挪威的大学、研究机构及公共事业单位已与中方相关部门签署了相关的合作意向书。挪威公司的商业活动也在呈上升趋势，并与相关的机构建立了直接的联系。

基于上述背景，挪威研究理事会进行了持续不断的努力以加强增强的双边科研合作。然而，中挪双方在文化、科研方式及基金资助机制等方面存在着差异。有鉴于此，挪威研究理事会投入了人力、物力研究中方科研新体系，例如参与了合作和发展组织(OECD)关于中国科研新体系评估，借此与中方主要相关机构建立了合作关系。本报告列出了中国的重大发展和科研新体系的主要特征，本报告例明挪威公司是如何适应这一体系的。本报告有助于了解中国的科研新体系，是制定双边合作计划的重要依据之一。希望本报告能引起多方的兴趣，可将其作为一般背景材料和进入中国市场的指南。

Kari Kveseth / 卡黎·柯威

挪威研究理事会
国际合作部主任
2008年3月

Preface

China's integration into international economic, political and cultural relations is a vivid illustration of today's globalized world. As an emerging economy, China puts increasing emphasis on developing its innovation system, which is having a major effect globally. Chinese research has been restructured several times in the later years. The number of institutions has been reduced and the quality improved. International cooperation is encouraged, and China is performing well on indicators for scientific publications. In January 2006 China approved a new 15 year plan for research with the ambition of making China a knowledge- and innovation based economy by 2020. From an investment of 1,34 % of GDP in 2005 the goal is 2,5 % in 2020. China is today the fourth largest economy in the world. China's goal is to continue its growth by investment in science and technology.

The Norwegian Government has prioritized China for increased bilateral research cooperation. In 2007 the Government presented its new China Strategy where research is emphasized as an important means for increasing the interface and strengthening the bilateral cooperation between Norway and China. The Government's strategy intends to promote Norwegian business interests, Norwegian expertise and Norwegian values as well as to integrate environmental, climate change and sustainable development into all Norwegian efforts.

A new bilateral agreement on research and technology at central governmental level is expected to be signed this fall. In addition the Research Council manages several agreements with different Chinese institutions. Norwegian universities, research institutes and public administration have already established cooperation agreements. Norwegian businesses are increasing their presence in China, and are establishing contacts with Chinese research institutions on their own.

On this background the Research Council has in recent years increased its systematic work to facilitate increased research cooperation with China. But the Chinese culture, financial instruments, means and grant systems are different from ours. The Research Council has therefore also invested in understanding the Chinese research and innovation system, for example through participating in OECD's review of the Chinese innovation system, and established contact with the major players. This report highlights significant developments in China, key features of the Chinese innovation system and how some Norwegian firms have adapted to this system. The report contributes to our understanding of the Chinese system, and is one of several inputs to our development of actions plans towards increased cooperation with China. Hopefully it will also be of interest to various stakeholders both as general information and background, but also as a guide to future actors in the Chinese market.

The Research Council of Norway, March 2008
Kari Kveseth
International Director

Table of contents

Preface.....	5
Table of contents	6
1. Introduction	7
2. China: A new global economic partner.....	9
2.1. China's economy: The great transition	9
2.1.1. Introduction	9
2.1.2. Main stages of the Chinese economic development since 1949	9
2.1.3. Trends in economic development	10
2.1.4. Structural changes	11
2.1.5. The development of Chinese industry.....	12
2.1.6. Regional variations.....	12
2.1.7. Reduction of poverty and increasing inequality.....	14
2.1.8. Increasing pressures on natural resources and pollution.....	14
2.1.9. Outlook.....	15
2.2. The changing role of government and policy environments.....	16
2.2.1. The government in the planned economy	16
2.2.2. More space for the market economy	16
2.2.3. Globalization and WTO	17
2.2.4. Institutional challenges.....	19
2.3. The Chinese innovation system: a changing environment for foreign business.....	20
2.3.1. Key trends and changes.....	20
2.3.2. The role of programmes	23
2.3.3. Towards an enterprise centered NIS	23
2.3.4. The Chinese labour market	24
2.3.5. Summing up: What kind of system?	26
3. Norwegian enterprises in the Chinese innovation system.....	28
3.1. Norway and China: mutual benefits.....	28
3.2. Some theoretical considerations.....	28
3.2.1. Globalising enterprises:.....	28
3.2.2. Data collection and selection of firms.....	30
3.3. Old products in new markets?.....	31
3.4. Ownership and alliances.....	36
3.5. R&D and innovation activity	38
3.5.1. R&D labs.....	38
3.5.2. Networks and collaboration	40
3.6. The legal environment and government interface.....	41
3.7. Management practice, training and employee loyalty	44
3.8. Clusters and networks	46
4. Conclusions and implications.....	49
4.1. Summing up	49
4.2. Comparing with Sweden	50
4.3. The public support system and implications for policy	51
References	53
Annex: List of interviews	55

1. Introduction

Since the opening up of the Chinese economy in 1978, China has had a tremendous economic development. It has had an average economic growth rate of more than 10% per year. Some 400 million of its 1.3 billion citizens have been pulled out of poverty. While China 40 years ago was the country with the smallest socio-economic differentiation, it is today one of the countries of the world with the largest gap between the poorest and the richest.

As China gradually opened its borders to trade and investment, even becoming a member of the World Trade Organization (WTO) in 2001, business communities in the industrialised countries have looked upon China as the country with the vast opportunities. Foreign companies have migrated to China, resulting in levels of foreign direct investments (FDI) and relocations of business hardly seen before on such a scale. This process of relocation was at its peak in the 1990's and the early years of 2000's, and was guided by a combined effect of cheap, abundant labour and a potentially vast market.

However, over the past decade or so, it has become ever more evident that the strategic intentions of the flow of capital and other resources from industrialised countries to China were to a lesser degree motivated by cheap labour. It is clear that China became the workshop of the globalised international economy, but business communities and corporations around the world took increasingly a broader interest in their presence in China, acknowledging the fact that China had a capable labour force in science and technology. Further, to reap the benefits of the growing Chinese market, R&D operations were necessary in China itself. Hence, foreign companies established R&D labs and entered into joint ventures with Chinese companies to better engage with knowledge networks in China. In sum, the Chinese national innovation system changed dramatically over the past 20 years.

One notable change in China has been its national innovation system. In 1978, the Chinese economy was centralised and planned, with no private sector. The science system was in line with the legacy of the Soviet system, with some huge scientific organisations like the Chinese Academy of Sciences, and with the manufacturing industry organised as state owned enterprises. Contradictory processes evolved, such as the parallel process of brain drain out of China from the late 1970s and onwards with the increasing foreign direct investment the opposite direction. However, as will be shown in this report, the Chinese innovation system has undergone dramatic changes, with great public investments in R&D, restructuring of the science system, reforms of the economic system and gradual introduction of a legal environment that is more conducive to innovation. With all the challenges still remaining in the innovation system, it has become clear that China is now an attractive location for business, as well as a formidable competitor globally.

Norwegian companies have migrated to China as well. According to Norwegian authorities some 200 companies have established operations or at least a presence in China. Not much is known about their lessons and experiences in operating in China and relating to the Chinese innovation system. Further, not much is known about how they see their competitive advantage, how they relate to the Chinese knowledge networks, business environment and policy frameworks.

Hence, the project¹ on which this report is based was aimed at researching these issues, with the final aim to cast some light on what possible policy implications could be derived for Norwegian innovation policy. This will also be done in the context of a recent study of Swedish business in China and how the competition from China can be met by Swedish industry.²

The report attempts to answer the following questions:

- a) Which are the significant developments in China over the past decades that have a bearing on China's role in the global economy, and how has the exchange relationship between China and Norway developed?
- b) Which are the key features of the Chinese national innovation system in which foreign firms locate?
- c) How to Norwegian firms adapt to this system, how do they innovate, which are the main lessons from the Norwegian presence in China and for Norwegian public support?

This report is written in three broad sections: In the first section a context for Norwegian business in China will be discussed. This includes an overview of the Chinese development over the past few decades, key changes in the Chinese innovation system, as well as a discussion of the nature and impact of Norwegian-Chinese economic relations. The second section contains an analysis of Norwegian businesses in China, the key lessons and experiences across sectors and types of firms. The analysis is based on semi-structured interviews with company representatives in China, drawn from a list of Norwegian companies in China made available by Innovation Norway's office in Beijing. The list of interviewed persons and companies is presented in the annex to this report.

¹ The project has received financial support from the Research Council of Norway, project number 186745.

² Schwaag-Serger, S. og Widman, E. Konkurrencen från Kina: Möjligheter och utmaningar för Sverige. ITPS, Stockholm/Östersund 2005.

2. China: A new global economic partner

2.1. China's economy: The great transition

2.1.1. Introduction

The Chinese term their development “industrialization in a broad sense”, meaning that efficiency and productivity improvements through market orientation, technology and internationalisation were to have impacts across all sectors, not only manufacturing industries (Mengkui et al 2004). Through a series of 5-year plans and long term objectives, the aim is to develop China to a “modern social-economic structure”. Contrary to the rapid privatization and liberalization of the Soviet and Eastern European countries in the 1990's, China was to be developed through a parallel system of a planned and a market economy, gradually reforming economic and other institutions.

Reforms in the macro-economic environment have hence been delayed and priority has been given to more micro-related changes. Further, and in line with this, STI policies and the innovative capacity of the Chinese industry has been seen as key to the upgrading of the Chinese economy. In fact, science and technology is not only seen as important in this process, but as the cornerstone of modernization and upgrading.

Since the spontaneous breakdown of the agricultural commune system during the late 1970's, China gradually introduced contractual arrangements in that sector to reach a semi-private or household based agricultural sector by mid-late 1980s. The acknowledgement of the advantages of a more decentralised system, led to experiments also in state owned enterprises, and over the years to a broad strategy for economic renewal. As the current development of the Chinese economy and society has a broad basis and includes agriculture as well as manufacturing and service sectors, and also includes modernization of the development process to include environmental and social sustainability (Mengkui et al 2004), a broad and comprehensive focus of the role of function of science, technology and innovation should be expected.

2.1.2. Main stages of the Chinese economic development since 1949

China was the largest economic power in the world for most of history until the mid-19th century when Western Europe surpassed China following the Industrial Revolution. The lack of modern industry caused China's relative importance in the world economy to decline until the mid-20th century.

The economic condition and environment of the early years after 1949, the year of the Chinese revolution, was characterised by a poor and destroyed domestic economy and a hostile external economic environment. China was faced with the economic embargo by the US, and had weak economic ties with the rest of the western world. Under such conditions, economic assistance from the Soviet Union became the main source of support, including for science and technology and investments. In 1952, a Chinese government delegation led by Prime Minister Zhou Enlai agreed with the Soviet Union in Moscow on an assistance package consisting of 156 major investment projects during the first five year plan period, to lay the foundation for Chinese modern industry and economic growth. However, the implementation

of this plan was interrupted, leaving many of the projects unfinished, when the Soviet withdrew its experts from China as a result of the deteriorating relationship between the two countries in the mid-1950s. The Soviet economic assistance programs had a strong impact on the Chinese economy. The science and technology system was no exception to this influence.

In the first five year plan period, the government estimated that there was a shortage of 110 thousand engineers and technicians needed for the industrial development³. China also succeeded in attracting key scientists from abroad, who played an instrumental role in laying the basis of the modern Chinese S&T system.

The next stage of economic development covered the catastrophic period of “The great-leap forward” lasting from 1958 to 1963. In this period the main driving force was based on revolutionary ideology, which excessively emphasized the human input as the key productive force. This resulted in downplaying the role of the S&T in the economic development, and in severe mismanagement of the economy. It continued with the similarly catastrophic cultural revolution that lasted until 1976. Although guided by ambitious goals to compete with the western world and turn China into a modern industrialised country, these almost 20 years of mismanagement and oppression led to economic stagnation and degradation, as well as increasing poverty and starvation. The early build up of a Soviet based science and technology system was neglected, and China lost 20 years of modernisation.

The last significant period covers the reform and opening up since 1978, initiated by Deng Xiao Ping. Since liberalisation began, China has experienced rapid growth and is emerging as a major player in the world economy. China started to regain global economic importance in the early 1970s concomitant with its rapid industrial development. Since 1993, China surpassed Japan to become the world's third largest economy after the United States and the European Union. China's importance in the world economy has grown in parallel with the rise of domestic economy. China became a member of the World Trade Organisation (WTO) on 11 December 2001. China's WTO accession will give rise to new growth potential - fuelled by manufacturing and services sectors - which will undoubtedly strengthen its economic position in the global economy in the future.

2.1.3. Trends in economic development

The communist revolution in China signalled the beginning of a structural development that should continue through dramatic steps and policy changes. In 1952, 60% of GDP was related to agriculture. Similar to the Soviet development China embarked on an industrialization process that changed the economic structure in a profound way. By 1978, agriculture's share of GDP has dropped to ca 35%, while industry and construction has increased from 10% to some 40%. And by 2003, after more than 20 years of liberalisation and introduction of a “socialist market economy”, the GDP structure is made up of 14.6, 52.2 and 32.2 % respectively for the primary, secondary and tertiary sectors (Maddison 1998, Lundvall 2006).

During the past decades, China's economy has grown almost 10% year on year, supported by an openness to trade that is illustrated well by the fact that by 2004 the imports and exports averaged 35% of GDP. The growth pattern has been export led supported by dramatic integration in the world economy (see table 1). The structure of exports has gradually changed, from primary products making up more than 50% in 1980 to less than 10% in 2002, and the

³ Report by Chen Yen on the first 5-year plan to the communist party downloaded from the NDRC website

share of manufactured goods reached 90% (Lundvall 2007). Still, the employment structure has not changed to the same degree, and employment in the agricultural sector remains at approx. 50% of the labour force. Hence, the economic development is much based on investments in fixed capital and corresponding productivity growth (ibid). But this fact also illustrates the critical need for job creation to sustain improvements in living standards.

Table 1 Openness of China to the global economy

	1978	1989	1997	2002	2003
GDP (¥100 million)	3624.1	16917.8	78973	120333	135823
Sum import and export (¥100 million)	355.0	4156.0	26967.2	51378.2	70483.5

Source: Lundvall 2007, China Statistical Yearbook 2004.

2.1.4. Structural changes

Two structural changes have provided much of the impetus for China's rapid industrial development since 1978: privatisation and greater international openness. The shift in industrial ownership structure from state-owned enterprises (SOEs) to 'non-state' enterprises started with creation of township and village enterprises (TVE) and other collectively-owned businesses, then foreign-funded enterprises, and more recently private domestic enterprises. Enterprises either wholly owned or controlled by government entities now account for less than 30% of industrial output. However, SOEs consume about two-thirds of China's credit resources, virtually all funds mobilised through formal capital markets, and employ about 50% of the urban workforce, signalling continuing problems of inefficiency and overstaffing.

This transformation of industrial ownership has contributed to growth through shifting resources toward more efficient enterprises and by increasing competition. Competition has also been augmented by curtailing central planning mechanisms and moving towards market-based prices. Nearly 90% of retail prices are now completely market determined, the main exceptions being energy and other utilities. Increases in competition, however, have been uneven across industrial sectors. Protected industries -- featuring entirely or mainly SOEs -- include major utilities such as electricity and petroleum/gas extraction, but also mineral extraction, steel and other metallurgical sectors, automobile production, basic chemicals and tobacco.

The second structural change is the progressive opening of the Chinese economy to foreign trade and investment. China's average tariff rate fell from above 40% in the early 1990s to 15% at present. Since 1979, China has received a cumulative USD 347 billion in foreign direct investment (FDI). In recent years, foreign investment has averaged 4-5% of GDP. While the bulk of FDI has come from Hong Kong, Chinese Taipei and other Asian countries with large ethnic Chinese populations, main OECD countries have important roles as source of FDI and technology transfer to China. FDI has been largely concentrated in coastal provinces, which feature special economic zones (SEZ), and to manufacturing industry, including increasingly high technology sectors, such as ICT and telecommunications.

Consequently, foreign invested companies play an increasingly important role in the Chinese industry and exports, despite the fact that key strategic industries are still closed to FDI.

The opening to international trade and investment has increased competition, spurred the growth of domestic labour-intensive industries and helped to develop China's exports. Consequently, China has emerged as an important trading nation, with total trade in USD 474.3 billion, accounting for around 4% of the world trade in 2000. Since 1994, China has consecutively run annual trade surpluses amounting to 245 bn\$ a year pr august 2007, which led to a growing foreign currency reserve, one of the largest in the world. Foreign enterprises in China have also been instrumental in developing China's export industries, particularly in recent years as FDI inflows have shifted toward capital- and technology-intensive export sectors. Foreign investment has also helped to raise industrial productivity and to improve industrial technology, know-how and worker skills. However, trade and investment liberalisation are not sufficient to improve China's industrial competitiveness, which is dependent on extensive restructuring of firms and reallocation of resources, and technological upgrading.

2.1.5. The development of Chinese industry

Industry has been the driver of China's phenomenal economic growth of the past 50 years. Over the past half century, China has become increasingly industrialised. Industrial development has hastened since reform began in the late 1970s, growing at an annual rate of over 11% between 1978 and 2000 compared to an average GDP growth rate of 9.6% during this period. The weight of industrial output in the Chinese economy has increased over time, from 21% of GDP in 1952 to 51% at present.

During the past 50 years, China's industrial structure has evolved in three phases. *First*, there was a period of heavy industrial development during 1952-78. The government prioritised the development of heavy industries (e.g. steel, machinery and chemicals), whose share in total industrial value-added increased from 33% in 1952 to over 70% in 1978. *Second*, in 1979-94, China diversified its industrial structure by emphasising lighter manufacturing industries, such as food and textiles. Since 1995, Chinese industry has suffered from massive over-capacity resulting from extensive industrial investment. To rectify structural weaknesses, China entered its *third* period of industrial development, which was focused on expanding technology-intensive sectors and upgrading the technological level of industry more broadly.

In sum, it is fair to say that China has gone through two stages of economic development, the first as a closed industrialisation period until 1978, the second as a gradually opened economy integrated globally. The second has also seen the critical role played by foreign direct investment (FDI) and multinational companies exploiting the opportunities of labour and product markets in China, but also providing important stimuli to restructuring domestic companies.

2.1.6. Regional variations

China is well known for its regional variations. Sigurdsson (2004) has recently conducted studies on the regional diversity and variations in China. He emphasises 3 main regions where much dynamism is currently concentrated, the Yangtze River Delta, the Pearl River Delta, and the Bo-Hai Rim. Sigurdsson argues that even though industries in China are unevenly or even weakly supported by state level programmes and initiatives. However, these regions are increasingly supported by provisional cities and regional programmatic structures, as well as the gradual formation of industrial cluster structures. This development has been greatly

stimulated by foreign direct investments that essentially placed China's innovation system in a global position. The three regions mentioned above represent 5% of China's land, 20% of the population, and may represent some 2/3 of China's GDP by 2025 (ibid). Hence the regional structure is extremely varied with strong concentration of STI resources.

Sigurdsson refers to 4 categories of cities or centers in China in the context of two facts: firstly that China is reasonably industrialised with some 50% of GDP coming from manufacturing industry, and secondly that China is far less urbanised and that agglomeration patterns have had their own, national logic:

1. The early commercial and industrial development in China created cities like Shanghai, Tianjin, Wuhan, Guangzhou, Qingdao where foreign powers played an important role until 1949. These cities were only weakly linked to the hinterland, although they played a very important role as commercial centers and industrial agglomerations.
2. A second type of cities, located inland or away from major waterways may be connected with political and military power. They are exemplified by Xian, Chengdu, Jinan, Taiyuan etc., and were less dynamic and often very slow in their industrial development.
3. The third type of cities includes primarily emerging industrial and mining cities such as Tangshan, Datang, Anshan etc. They followed the development of infrastructure such as railways and the development of natural resources. Their expansion took place following the strategy of central authorities. They were primarily developed as highly focused on certain products and generally lacked integrated service facilities.
4. A fourth type emerged recently and among them are the industrial cities that have been fuelled through the combination of heavy foreign direct investment, strong local support and new material and knowledge infrastructures. Outstanding examples are Shenzhen and Dongguan in Guangdong, Wuxi and Suzhou in Jiangsu, and Yantai and Weihai in Shandong" (Sigurdsson 2004: 8-9).

A key development in China in terms of regional innovation policy has been the establishment of 53 New and High Tech Industry Development Zones. These have been fitted with special regulations and governance structures to ease the flow of FDI and other resources. Further, China has developed and implemented 6 other regional programs: Special economic zones, open coastal cities, national level economic development zones, coastal economic open zones, export processing zones and bonded areas.

Over the past decade, the growth in these zones have been partially spectacular, with a 50% growth in the 53 high tech zones on a year to year basis, and a growth in the number of workers from 140 000 in 1991 to 3.49 million in 2002 (see ibid)⁴. However, Sigurdsson makes a point of the variable growth conditions and environments for these development zones in referring to the Zhonguancun development zone in Beijing that operates in the vicinity of a great concentration of R&D institutes, e.g. under CAS, and the two main universities Beijing and Tsinghua universities.

The regional variation in China's development seems to be influenced by what is termed the Chinese Economic Area (CEA), a geographical area comprising China mainland, Macao, Taiwan and Hong Kong. This wider economic area has developed more despite of than

⁴ See also Cao, Xiao, Plugging into high-tech, China Daily. September 20, 2003..

because of governmental negotiations and initiatives, and is heavily influenced by informal business and other diaspora ties like common culture and language. China's integration in the global economic and technological system is especially enhanced by the networks arising out of the CEA (Sigurdsson 2004).

2.1.7. Reduction of poverty and increasing inequality

The tremendous growth of the past decades has led to a contradictory development in China. First of all, poverty has been reduced on a scale the world has not seen before. China has seen a decline in overall poverty rate from 32% in 1970 to 3.1% in 2000 (Sala-i-Martin 2007). The World Bank, using survey data, found that the poverty rate fell from 53% in 1980 to 8% in 2000 (Chen and Ravallion 2004). Different ways to measure poverty cannot hide the fact that the transformation of China has brought some 250-300 million people out of poverty. The development in China explains to a great degree why this period has been the first the industrial revolution that had falling individual income inequalities globally (Sala-i-Martin 2007).

Hence, the Chinese economic development cannot be seen as anything but successful. However, it has also changed China in another way. China was before the transformation started one of the most equal in the world, with almost absent socio-economic inequality between individuals. Today, China is one of the world's countries with the highest inequality (Sala-i-Martin 2007). On the one hand, this has been an intended development, as the government of China has accepted that to modernise the country and increase the overall wealth of its population, "some had to get rich first". The socio-economic problems have been compounded by the withdrawal of the Chinese state from typical welfare services like healthcare, pensions and education.

2.1.8. Increasing pressures on natural resources and pollution

The tremendous pace of China's economic development and growth has implications for the environment that cannot be overstated. The negative impacts of the resource intensive pattern of economic growth are felt virtually on every environmental indicator, and illuminates the fact that so far the policies for the transformation of China has failed to meet the needs in areas such as energy, water quality, air quality and public health. The overall costs of pollution in China are estimated to 7-10% of GDP pr year. More than 400 000 Chinese die of pollution each year⁵⁶.

One main concern is the fact that the growth is being fuelled by dramatic increases in primary energy consumption. The main energy source has been burning of coal, and with China's vast resources of coal, it will be key to China's energy system far into the future. The industrialization of China has taken place with little concern for environmental or pollution control mechanisms, while an export led growth of manufactured goods from energy inefficient plants and industrial processes has been stimulated also by regional governments' interests in pushing industrial output as far as possible. Further, the increasing dependence on energy to fuel growth has led to large increases in imports of oil to the extent that China's rise as an industrial power over the recent years has indeed affected global energy, in particular oil, markets.

⁵ http://www.hrichina.org/public/contents/press?revision_id=25771&item_id=25770

⁶ <http://www.state.gov/r/pa/ei/bgn/18902.htm>

A key concern in this context is the generally low level of energy efficiency in the Chinese economy. In all sectors such as manufacturing plants, buildings and transport, the energy efficiency is far below standards in western industrialised countries, making sustainable energy production and use one of the most pressing concerns in contemporary China.

Air pollution is widespread. Two thirds of the 338 cities in China is according to Chinese authorities considered polluted, and two thirds of these considerably or severely so. Health problems, including respiratory problems, are leading causes of death. Acid rain falls over 30% of Chinese territory. Air pollution is therefore also a highly visible problem of intense and almost unchecked growth.

The visibility is also great in another problem area: Water pollution as well as scarcity are affecting China's industry as well as population in general. As much as 90% of urban water bodies are polluted, and all the rivers of China are considered polluted with as much as half the population lacking access to clean water. Ground water levels are in many areas severely depleted. The scarcity in Northern China is so severe that it impacts negatively on prospects for economic development. Chinese authorities have therefore implemented a massive project to redirect parts of the Yangtze river to areas in the North.

The one single project illuminating the challenges in China today is the Three Gorges Dam project, an enormous hydro-electric power facility on the Yangtze river. On the one hand the project raises many environmental concerns such as the impact on erosion and biodiversity. On the other hand the project will contribute to cleaner energy production with a substantial output of electricity. Hence, balancing industrial and economic development with environmental quality will be an enormous challenge for China in the years ahead.

In the present context, however, a main challenge is to achieve sustainable development in China with a significantly more resource and energy efficient production system. For example, to produce the equivalent of 10 000\$ of goods, China uses 6 times more resources than the US, and about 3 times more than India⁷.

2.1.9. Outlook

The current development is likely to continue, and China's economy will increase in size to become similar to the largest in OECD over the next five years (OECD 2005). By the beginning of the next decade, China could become the world's greatest exporter. The transformation of the economic structure is likely to continue, with dramatic implications for urbanisation and migration. The current dismal environmental picture will be worsened if there is no effective intervention by the government to change the development path. However, the government of China has put in place a firm strategy for future development, with increasing weight given to science and technology, indigenous innovation, improvements in market conditions and the legal system. The main challenge is to keep the pace of growth to continue to reduce poverty, while at the same time ensure a more sustainable economic development.

⁷ Interview with deputy environment minister, Pan Yue: <http://www.opendemocracy.net/debates/article-6-129-2407.jsp>

2.2. The changing role of government and policy environments

2.2.1. The government in the planned economy

China has until recently not had any experience with the market economic system. The periods before the communist revolution were marked by a long tradition of monolithic rule of a traditional, multinational and less integrated society closed to the rest of the world, succeeded during the first half of the last century by social and political unrest and civil war. As the communist revolution was brought to success in 1949, two key changes took place: First, China became one nation (leaving aside Taiwan) under one system of rule, a development that still today explains the support Mao Tse Dong as a national leader. A unified China is closely linked to the communist revolution.

The second significant change was the one from a traditional and agricultural system to a planned economy and gradual industrialization much according to the Soviet system. The government during the period of the planned economy controlled all productive forces such that enterprises were state owned, and all decisions on production were taken by governmental bodies. The party had direct representatives at the enterprise level, and linkages between users and producers were few and far between. The producers were producing according to pre-defined production quotas, and these were in extreme periods targeted towards output levels related to an overall policy of maximal industrialisation without regard to needs or users. Micromanagement of the economy was the rule, giving the overall economic system poor conditions for adaptations and flexibility.

According to Fang (undated), several pitfalls in the S&T system became evident as the early reforms started in 1978. First, the system was highly isolated and vertical, with research organisations being responsible to their immediate supervising institutions. As the system was also fragmented with many ministries and governmental bodies specialised in their line of duty, the vertical nature of the system made it complex, without horizontal ties, and difficult to manage and coordinate. Second, the system had great difficulties in ensuring technology transfer due to a lack of an institutional framework for property rights and compensation for transferring institutions. Third, direct intervention on a very detailed level undermined initiative and motivation in the research community. And lastly, in Fang's words: "both the personnel composition at a research institute and its staff's knowledge structure became ossified as research bodies degenerated into isolated entities under such an over-rigid system".

2.2.2. More space for the market economy

The transformation process of the past three decades has given more space to the market economy. A number of small and large reforms have paved the way from a rigid planned economy to what is now regarded as a "socialist market economy". Although there is much reform work to be completed in years ahead to achieve an efficient market economy, the market as a key economic institution has already reached a level that ensures decentralised allocation of resources and price setting, as illustrated in table 2 below.

Table 2. Share of transactions conducted at market prices
Per cent of transaction volume

	1978	1985	1991	1995	1999	2003
Producer goods						
Market prices	0	13	46	78	86	87.3
State guided	0	23	18	6	4	2.7
State fixed	100	64	36	16	10	10.0
Retail sales						
Market prices	3	34	69	89	95	96.1
State guided	0	19	10	2	1	1.3
State fixed	97	47	21	9	4	2.6
Farm commodities						
Market prices	6	40	58	79	83	96.5
State guided	2	23	20	4	7	1.6
State fixed	93	37	22	17	9	1.9

Source: National Reform and Development Commission and Price Yearbooks, OECD 2005.

With increasing priority given to a more dynamic national innovation system, to be centered both on the enterprise system as well as on an indigenous innovation capability in China, market mechanisms will continue to be introduced. This concerns a range of areas related to innovation, from improved venture capital markets to IPR. Enterprises are expected to take the role as capable, innovative players in dynamic markets, investing not only in R&D, technology and patents, but also new organizational solutions, management practices, distribution channels and branding to name a few.

This development has, and will continue to have, significant ramifications for the role of government. With the expansion of the market economy, the government will have to take on the role as a competent, independent regulator. The government will have to decide on where and how to retain public ownership in the economy. It will have to redefine its role from micro manager to macro manager. This will address key issues in innovation governance, for example policy formulation and implementation, institutional design and accountability, governance of research institutes and universities, designing the frameworks for science-industry relationships and other public-private partnerships etc (OECD 2005b).

2.2.3. Globalization and WTO

The preceding analysis has illustrated well the importance and significance of the globalisation process. In fact, the current phase of globalisation may be seen as the third, building on the first two phases. The first was centered on the increasing trade across countries and continents, symbolised by the trade impact of Marco Polo's exploration in the 1200s. The second phase was related to major relocations of production that took place from the late 1970's and onwards. These relocations were mainly of low-skilled jobs being moved

from the industrialised countries to developing countries within the context of multinational companies (MNCs) and global production networks. The movement was one-directional, letting western enterprises and capital take advantage of low-paid labour in abundance in developing countries.

The third and current phase can be dated to start in the late years of the last century, and is based on two factors: First, the globalisation processes is changing to include one of globalisation of knowledge formation. Western enterprises and MNCs are increasingly relocating R&D activities to emerging economies like China, where the current growth pattern and investment in R&D are highly attractive for foreign firms. Second, the globalisation process is increasingly two-directional, implying that e.g. Chinese firms and R&D institutions take part in the globalisation and enter knowledge centers or activities in foreign countries (Long and Laestadius 2005). Long and Laestadius present 6 dimensions or characteristics of the current globalisation process:

- The depreciation rate of knowledge has never been so fast and the exchange of knowledge has never been so intense;
- Knowledge flows in both directions, or many directions, pointing to the fact that participants in developing countries and emerging economies are part of the game on an increasingly equal footing;
- The current globalisation of knowledge is both random or fluid as well as highly organised in established economic structures. The capability to take part in global knowledge networks is crucial for both small and large players;
- Knowledge formation is less based on intramural R&D and more on external links, giving more importance to risk-sharing and flexibility;
- Globalisation of knowledge has strong political dimensions, with strong governmental efforts to create regional systems and zones that provide excellent opportunities for knowledge based growth;
- The globalisation is increasingly also based on initiatives from players to engage in and acquire western knowledge and market opportunities.

The current transformation of the Chinese economy and innovation system is both influencing and being influenced by this process. The Chinese government's decision to join the World Trade Organisation (WTO) in 2001 was also a formalisation of China's partnership in this process. The Chinese government also realised that the technological challenges ahead would intensify, and that with formal inclusion in the world economy China would have to adhere to stronger restrictions to governmental protection of the Chinese economy. Accession to the WTO implies a significant reorganisation of the national system of technological standards and policies such as public technology procurement (Suttmeier and Xiangkui 2004). China finds itself in an uncertain position at this juncture, precisely described by Suttmeier and Xiangkui (*ibid*, p 4-5):

“China's market size and increasingly capable technical community give it unique advantages for challenging the established technological architecture found in the international economy. At the same time, however, our analysis indicates that China cannot do this alone, that there is substantial foreign participation in the technological development underlying the standards strategy, and that there are multiple interests at stake in standards development.... China has become a major arena for global competition among MNCs, that many Chinese firms may actually have interests in the standards established by the global technology leaders rather than in those set by the

Chinese state, and that the politics of standards is likely to be characterised by increasingly complex and cross-cutting cleavages.”

Hence, the process of globalisation has complex impacts on the role of government in China as the transformation process intensifies. A key challenge will be to find ways to sustain a domestic development in capabilities for innovation while at the same time govern according to rules and spirits of the global economic community.

2.2.4. Institutional challenges

As China continues the modernisation and upgrading process, there will be several challenges in transforming in the role of government to become conducive to a market economy and an enterprise centered innovation system (see next section):

- *Providing public goods:* In a market economy there is a need to decide on who should produce or provide what. As the state pulls back from immediate production of goods and services, it will need to define its role in the provision of them according to a normal division of labour between the public and the private sector. There is no fixed or optimal solution that fits all countries, it has to be developed according prevailing conditions in each case. But a core task for governments in a market economy is to provide public goods, that is goods or services that the market as an institution cannot provide. For example in the case of S&T policy, the government will typically concentrate funding on basic R&D and other long term or strategic efforts while leaving the development and technology to the market.
- *Building a legal environment:* The implicit or practical arrangement for governmental behaviour in the planned economy has been a great discretion of action to the point that it “can do anything not clearly prohibited by law” (Fang undated). Hence, the government has had great authority in governing the country, typically with reference to the legitimacy of the communist party and its doctrines or “theories”. The market economy and a new innovation system will need to be built on a legal environment that both reduces the immediate power and degree of discretion for the government and provides sufficient security for the private sector to engage in normal economic activities. This process is well underway, as the government for example has enacted the law on S/T progress, the patent law and other legislative measures. However, there is still a great task ahead in transforming the overall all system to be built on a pervasive legal system with proper enforcement and political and cultural support.
- *Establishing a functional set-up of state organisation:* Defining the role of government includes institutional design. As the innovation driven, global economy continues to challenge state organisation in most countries, this particular priority is key to the Chinese development. The legacy of strong vertical structures of the state with many overlapping functions is not supportive for a dynamic innovation driven economy. Two priorities seem particularly important: First there is a need to address the functional division of labour between policy and management. This is in particular important in the case where the state remains an economic actor. Second, in line with many other countries (OECD 2005), there is a need to develop an appropriate system of institutions with responsibilities for co-ordinated action and policy deployment. As the policy environment becomes more complex and dynamic, sectorally based ministries will often represent a co-ordination deficit leading to less coherent policies than optimal. Development and design of agencies is a typical case, though which

governments may govern through policies and plans while establishing criteria for accountability and responsiveness.

- *Ensuring policy formulation and implementation to support policy agendas:* Most political systems develop comprehensive agendas to respond to more dynamism, globalisation and change. Key to these responses is their national innovation systems. China has a long tradition in developing such agendas with its long term planning. However, and in line with the above point, there often exists an “implementation gap”. Governments typically have less capacity for coherent formulation and implementation of policy than needed. While agencies are often designed to ensure this, this priority is of a wider concern: Governments increasingly need to address mechanisms of ministerial co-ordination, policy coherence, implementation and policy deployment, design and bundling of policy instruments, tools for policy learning through creation, diffusion and use of policy relevant knowledge, as well as developing linkages to bodies and expertise.

2.3. The Chinese innovation system: a changing environment for foreign business

One of the marked changes in China over the past decades has been the revitalisation of the science and technology system. In fact, the reforms that have changed China during this period have included deep changes in the science, technology and innovation system, as this system was seen to play a key role in the modernisation of China. The early reform “Four Modernisations” included deep changes in four sectors, one of them was in science and technology. The changes that were induced from the early 1980’s were in particular directed towards revamping the system after decades of mismanagement through relying on the Soviet model and through the devastating Cultural Revolution.

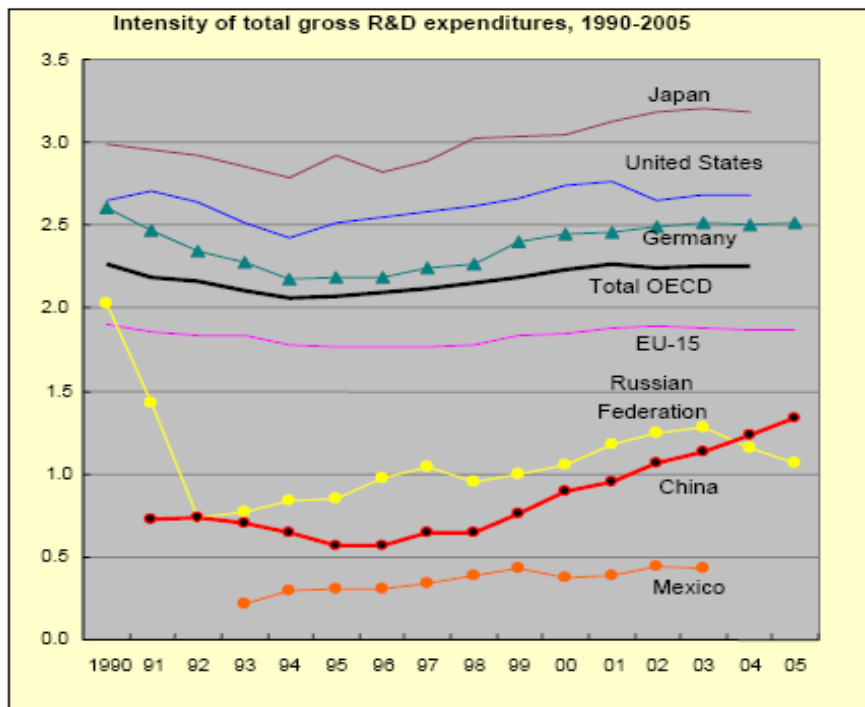
This section gives a brief overview of the trends and situation of the Chinese innovation system, with the purpose to provide an understanding of what kind of environment the Norwegian businesses in China have to adapt or relate to. It relies on recent work by OECD⁸.

2.3.1. Key trends and changes

The most notable change in the Chinese innovation system has been the commitment to invest in R&D. From a R&D/GDP ratio in 1995 of only 0.6%, this ratio reached in 2005 1.34%. This is remarkable given the fact that the average economic growth rate has been some 10% over many years. R&D spending has increased by an annual rate of 19% since 1995. So even if the Chinese R&D system may still be small on many accounts, the rate of change and growth on some indicators point to a shift also in a global context that is remarkable.

⁸ OECD 2007: OECD Reviews on Innovation Policy: China. Synthesis Report. Paris.

Fig. 2. R&D intensity

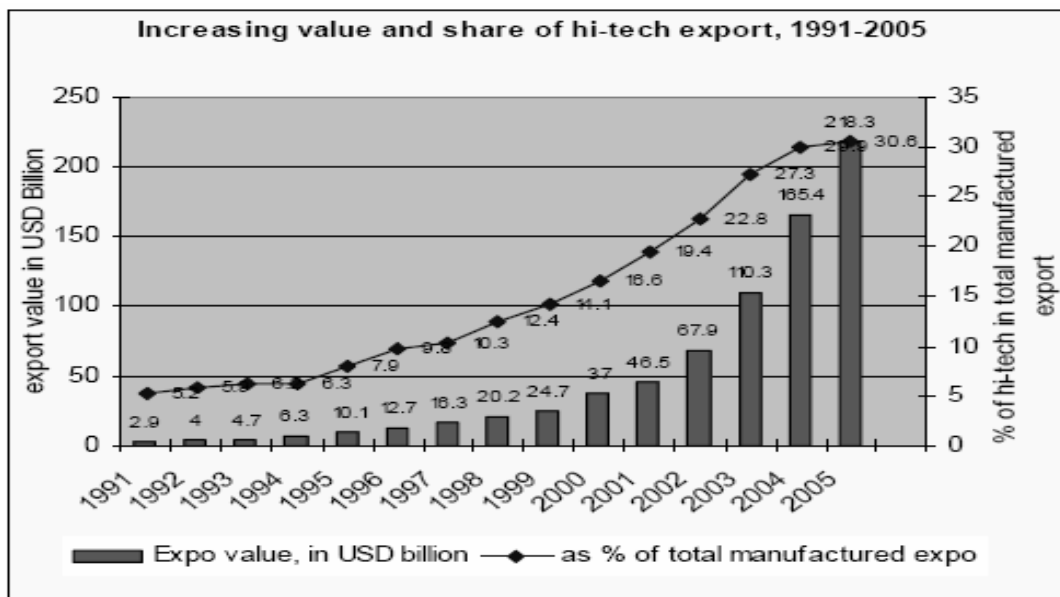


Source: OECD, MSTI database 2006/2.

However, contrary to the typical picture in OECD countries, the R&D efforts are mainly development activity. Some 70% of the R&D is experimental work, while only 6% is basic research. Only a few universities perform substantial R&D, and although a major research organisation like the Chinese Academy of Sciences has been restructured and reformed, the profile is one of too little basic research.

The Chinese economy has undergone a broad structural change from agriculture to manufacturing and services as measured in GDP. However, this has not been followed by a similar shift between the sectors in terms of employment: About 50 % of employment is still in agriculture. Over the years, there has been a tremendous growth in high-tech exports, supported by high inflows of foreign direct investment and even related imports. Hence, the Chinese economy has not been as high-tech as can be seen from the figure below, it can be paraphrased that China as some islands of excellence but that economic miracle stems to some extent from its ability to serve as an assembly workshop of the world.

Fig 3 High tech exports



Source: MOST website: <http://www.sts.org.cn/sjkl/gjscy/data2006/2006-2.htm>

Hence, there has been more “piggyfrogging” than “leapfrogging” in the Chinese innovation system (Economist Nov. 10, 2007): China has “made clever use of foreign technology – assembling it, copying it, servicing it and customising it – but their firms have yet to create very much to rival it”. However, the system has been capable of providing new combinations and finding new uses of existing technologies, thus pushing “architectural innovation” that may be scientifically modest, but may be commercially viable (ibid).

The Chinese innovation system has moreover an important structural feature. Its dynamics rest to a significant degree on the Eastern regions like Beijing, Shanghai, Guangdong and Schenzen, areas that have seen persistent inflows of capital through diaspora networks in offshore locations like Hong Kong and Taiwan. Other noticeable features of the Chinese innovation system are:

- A lack of human capital, both for industrial and scientific purposes. The education system is being improved and expanded, but there are still obvious challenges to solve in human resources. This problem is compounded by the fact that foreign companies located in China offer better conditions than Chinese, leading to often severe problems for Chinese companies to recruit competent personnel.
- Protection of intellectual property is still a challenge. However, as stated at the recent OECD conference in Beijing in August 2007, companies typically adapt to this problem through leaving the most sensitive R&D and technological work in their home countries. Instead, the greater worry is often confidentiality and the lack of loyalty among Chinese employees.
- Although China can be termed the “assembly shop of the world”, it is also becoming a tempting location of foreign owned R&D centres. For example, Xue and Liang reports

some 750 such centres in China today⁹, a development being motivated by the low cost of Chinese scientists and experts as well as the proximity to a large and expanding market.

- A persistent problem relates to immature regulation and framework conditions. The “rule of law” is still developing, and a number of areas are still suffering from poor regulation, including labour relations, IPR environmental standards etc. Further, financial institutions are a weak point in the innovation system, with poor regulation, significant bad loans typically to state owned companies, as well as a lack of venture capital and a culture of entrepreneurship.

2.3.2. The role of programmes

A characteristic of the Chinese NIS and innovation policy is the proliferation of programmes. In fact, the large number of comprehensive and ambitious programmes is a major tool in the implementation of innovation policy in China. Table 3 gives an overview of the main programmes making up the targeted funding of R&D and innovation. It is fair to say that the programmes have been a significant tool for the Chinese government to define and implement S&T policies, and have in general had a great impact on the evolving innovation system.

The programme portfolio can be grouped in a “3+2” system:

3 core programmes:

- The 863 programme
- Programmes for key S/T issues
- Basic research programmes

These are matched with another two groups:

2 groups:

- R&D infrastructures
- Technological industrial conditions

Without going to deep into this area, some observations are noted:

- A great chunk of the resources are allocated to programmes supporting innovation and technological development. Basic research accounts for a smaller share of the overall programme budgets.
- The programmes are characterised by a top-down approach in defining research areas, while less is defined by market priorities.
- Private sector participation is relatively small in the programmes, and active relationships between science and industry is underdeveloped.

2.4.3. Towards an enterprise centered NIS

The objective of the current reform drive of the innovation system in China is to change the system from one centered on the public research system to one based on enterprises. This transformation has several implications for the role of government in the innovation system, and for the relationships between the public and the private components of this system.

⁹ Xue, L. and Liang, Z. Globalization of R&D and its Implication to NIS and China. Presentation to the OECD China NIS project, Beijing, 2006.

In the planned economy the research system was public, and the enterprise system was as well state owned. According to the Soviet model on which the Chinese was based, there was a sharp division between these two functions, and all R&D and innovation activities were presumed to take place in the research system. Hence the government had multiple roles in this system, including developing and implementing R&D policy, management of the R&D system, management of the enterprise system, co-ordination of the transactions in the technology transfer process from R&D to the enterprises etc. The overall characteristic was one of rigidity, with poor or non-existent innovation capabilities in enterprises, poor linkages between these and the R&D system, and partially outdated and irrelevant competence in the research community.

The current move towards an enterprise-centered NIS in China is changing this, and the government will have to redefine its role in the innovation system. The key idea of an enterprise-centered NIS is to ensure that innovation activities and investments are taking place close to or integrated in commercial decisions. These decisions are in a market economy decentralised to players in the market, while the government takes on the role of providing rules, regulations and incentives according to overall policy objectives and international norms. The wider implication of this that the government will have to put in place incentives, systems for institutional management, regulations for corporate governance, separation of productive from policy functions, and a system of laws and regulations that in sum will ensure the flexibility and adaptability of the innovation system. It will require institutional innovations to redefine governmental functions and activities on a large scale, including the role of R&D and innovation programmes and policies as well as more economic issues like the role, scale and scope of public ownership in various economic sectors.

2.3.4. The Chinese labour market

As innovation systems are basically institutions and mechanisms that produce, distribute and use knowledge, it is difficult to avoid a treatment of the labour market. In fact, the labour market and its institutions are to a greater extent seen as key to the operation of innovation systems, as it contains mechanisms for allocation of human capital, or knowledge embodied in humans. In this context, the labour market does not only include issues of supply and demand for human capital, but also levels of skills and competences, institutions for skills formation and training, and internal market mechanisms such as company training and management practices.

Table 3 Current R&D programs (source: MOST undated)

Program	Start year	Objective	Budget 2004
National High Tech R&D program	1986	Enhance China's international competitiveness and improve overall capability of R&D in high tech	5.5 bill RMB
Key Technologies R&D program	1983	Concentrate resources on key and common technologies needed for industrial and social development	1.5 bill RMB
National Program on Key Basic Research Projects ("973")	1997	Support basic research in selected areas	0.9 bill RMB
R&D Condition and Capacity Program	1984	Support development of infrastructure and capabilities through sub programs	NA
		<i>State key lab construction projects</i>	
		<i>Mega projects of science research</i>	
		<i>Nat engineering research centers constr.</i>	
		<i>S&T groundwork program</i>	
		<i>Public interest research program</i>	
		<i>Major international co-op projects</i>	
S&T Industrial Environmental Construction		Support and promote environmental projects, regional economic development, tech based SMEs, and S&T intermediaries	
	1986	<i>Spark program for rural development</i>	NA
	1988	<i>Torch program for high tech industries</i>	NA
		<i>National S&T Achievements Outreach program</i>	NA
	1988	<i>National new products program to serve as guideline for new and conversed products</i>	NA
		<i>Trade with science and technology for exports</i>	NA
		<i>Technical upgrading fund for SMEs</i>	NA
		<i>Agricultural S/T achievements Conversion fund for enhancing agricultural technology</i>	NA
		<i>Productivity promotion centers for technical upgrading of SMEs</i>	NA
		<i>University S&T parks</i>	NA
Major Dedicated National S&T Projects in 10 th 5-year plan		To enhance domestic strategic economic structuring with 12 projects based on the 863 and Nat Key Techs R&D Programs	NA

This report can only cover some broad issues related to the Chinese labour market. These also reflect some of the important challenges for Norwegian and other foreign companies locating in China. Adapting to and changing features of this labour market is therefore central to the innovative behaviour of firms, as it concerns developing and implementing new routines as well as integrating to a foreign setting.

The mind boggling fact about the Chinese labour market is its size. The workforce contains about 900 million people out of a total population of ca 1.3 billion. The economic development over the past 30 years has pulled some 400 million people out of poverty, much through offering new and better paid industrialised jobs or working opportunities in the rapidly developing services sectors. The official unemployment rate is 4%. However, the hidden rate is significantly higher, not least because of surplus labour in many sectors, especially in state owned enterprises (Hammerstøm and Lunnan (2008).

A further feature of the Chinese labour market is its development into a two-tier market. The Chinese pattern of growth has been uneven, leading to tremendous growth in the eastern areas that has offered new and also highly skilled job opportunities, while the central and western sections of the country have seen much less of this. This has had the consequence that a relatively smaller group has enjoyed increasing welfare, good income and promising opportunities in sectors that are related to foreign companies or otherwise engaged in the rapidly expanding export industries. The other and bigger group consists of poorly paid farmers and an increasing pool of migrant workers. The current pattern of urbanisation and relocation of jobs implies that there is a need to create some 20 million jobs pr years in the secondary and tertiary sectors.

The rapid growth and the inadequate education system have led to a shortage of skilled labour to the extent that the costs of this labour are currently on the rise. Anecdotal evidence points to only 5% of the Chinese working population being skilled enough for modern industrial enterprise. The skilled group therefore has good opportunities in the Chinese market, often being able to pick new employers and engage in “job hopping” to achieve attractive benefit packages. Cook (2005) terms this group the “Golden Collars” (Hammerstrøm and Lunnan 2008). The Chinese market is however, benefiting to some extent from returnees from overseas, from the great pool of “brains drained” over the past decades, be they scientists or students or other highly skilled people. This process of reversing the brain drain has been encouraged by the Chinese government to help close the gap between the supply and demand for skilled labour.

A noticeable feature of the Chinese labour market has been the employment contracts under the communist or planned economy. The “danwei” system of life long employment in a working unit administered centrally led on the one hand to the “iron rice bowl” for everyone, but on the other hand to low productivity and overstaffing (Child 1994, Zhu 2005). This system is also well known for its hierarchical set up, and the low sense of independence and responsibility among the Chinese employees.

2.3.5. Summing up: What kind of system?

As Norwegian companies, among a wave of others, migrate to China to set up operations there, it is pertinent to ask what kind of (innovation) system are they settling into? And how do they adapt to this system, and how do they influence it? These questions will be answered in the next chapter, while summing up this section gives an opportunity to paraphrase some features of the system into which they need to adapt.

First of all, the Chinese innovation system is still evolving and changing, in fact it is in a process of institutionalising. This means on the one hand that foreign companies have to incorporate a great deal of uncertainty and even inconsistency in the way the system

influences their behaviour. On the other hand, the Chinese system is still learning, and may receive important influences from foreign companies. Hence, the question of adaptation is a two-way one.

Second, and related to the first, it is expanding rapidly in terms of resources and capabilities, making it ever more interesting for foreign firms to locate innovation related operations there. However, as the economy is growing rapidly, there is a growing competition for these resources as well.

Third, the system is not sustainable. It is depleting natural resources and in the current development path it leads to significant environmental pressures. Further, although it has contributed to lifting some 400 million people out of poverty, it is creating significant socio-economic disruptions and differentiation, in particular between the rural poor and the growing middle class in the cities, as well as between the eastern regions and the middle and west of China.

Fourth and last, it is in the process of changing from a science to an enterprise oriented innovation system, with new policies supporting this development. This implies greater focus on science-industry relationships and the innovative capabilities of firms.

3. Norwegian enterprises in the Chinese innovation system

3.1. Norway and China: mutual benefits

The growing interest in establishing presence in China, takes place in the context of an expanding mutual relationship between China and the OECD countries. The bilateral relationship between China and Norway has been particularly beneficial, and particularly for the latter. This section briefly discusses this based on a recent study.¹⁰

The authors of the study state clearly that the impact of China (and India) on the global economy so far is only the beginning of a deep structural change. The entry of especially China in the world economy signifies in particular a growing surplus of labour, and hence a continued export of labour intensive products from those countries. As the Indian labour market is far more regulated than the Chinese, the effect of the latter will be far greater. Further, for the foreseeable future the OECD economies will partly compensate through continued increases in exports to the rising economies of capital and knowledge intensive products, as well as raw materials needed for the Asian industrial expansion. Gradually, in line with the changes in the Chinese innovation system and markets, the Chinese economy may be less export oriented and more geared towards a growing domestic market. And their exports may become more capital and knowledge intensive than seen so far.

Concerning the relationship between the Norwegian and Chinese economies, it is fair to say that it has been mutually quite beneficial. Norway has benefited tremendously through greater demand for products like oil and gas, as well as minerals. And there has been greater demand for the more advanced services companies from Norway, many of which have established operations in China. Norway has also benefited through cheaper imports from China, helping to suppress inflation pressures in the Norwegian economy. The terms of exchange between the two have therefore been very beneficial for both.

3.2. Some theoretical considerations

3.2.1. Globalising enterprises:

In the context of the advantageous exchange relation between Norway and China, as well as the growing attraction of a Chinese location for Norwegian companies, a short overview of some theoretical considerations is necessary to guide the analysis and discussion that follows. This concerns firstly a crude typology of firms as different firms have different strategic options to follow and different sets of resources and capabilities. The recent wave of globalisation will in particular discriminate between different approaches to go international, and more precisely, to “go Chinese”.

Grant (2002) has offered a useful typology that may prove helpful. He identified four types of firms with implications for their international or global participation:

¹⁰ BJORVATN, K. et al: De gode hjelperne. Virkninger av utviklingen i Kina og India for norsk økonomi. CASE/SNF, Bergen 2006.

- *Sheltered industries* are basically national and sheltered by way of regulation, restricted market access. However these are in many cases, through recent waves of deregulation and privatisation, increasingly participating in an international context;
- *Trading industries* internationalise through participating in a global market for their products or services, but mostly restricted to exports/imports;
- *Multidomestic industries* go international through foreign direct investment and setting up operations in foreign markets. This is typical for many service industries;
- *Global industries* are active both in trade and foreign direct investment, acting also as internal markets through sourcing.

Any country will “deliver” their companies to a new location like China according to their industrial or economic specialisation. For example, Schwaag-Serger and Widman (2005) in their study of how Swedish business respond to the competition from China, found a presence of larger, R&D based companies directed to a market for final demand in China among a broader set of companies in China. Such companies are more likely to set up R&D to develop products for a growing market with new specific requirements. Norwegian industry are more specialised in raw materials and intermediate, business-to-business products, and Norwegian presence will therefore be somewhat different.

This leads to a differentiation between various innovative strategies that may be followed. This becomes more clear using a simple two-by-two table (see below), containing the two dimensions of products and markets. The strategies will depend on perceptions of risk and uncertainty concerning a possible new location or investment, as well as other elements of operation related to the overall objective of a decision to locate in a foreign market. This concerns in particular some key strategic choices concerning the nature of a presence in a foreign market. Thompson and Strickland (2003) differentiate between five options:

- Exporting, implying no presence other than a representative office;
- Licensing strategies, contracting with a partner a right to exploit certain assets;
- Franchising strategies, contracting to a partner the right to exploit a brand name and a business model in return for a royalty;
- Joint venture or strategic alliance, contracting with a partner to do business together;
- Direct investment or wholly owned subsidiaries, implying full, independent presence.

Table 4 Innovative strategies

Market Product	New	Old
New	New products in new markets demanding significant FDI, long term presence, R&D	Outsourcing or relocation of R&D to serve existing markets
Old	Relocation of production of existing products, some development or application necessary	Location to ensure low cost sourcing to existing markets

The innovative behaviour of Norwegian enterprises in China will therefore depend on their rationale for locating in China, as well as their perceptions of the Chinese innovation system and related factors that influence the approach chosen in terms of structural solutions as alluded to above. Although information is readily available about the rise of the Chinese economy, there will in most cases be much uncertainty about the nature of the Chinese system, and how to do business and innovate in China. The Chinese innovation system, including the legal environment and other broader issues, represent great uncertainties as described in the former chapter, and the general proposition in this chapter is that Norwegian enterprises will approach prudently and opt for protective solutions to operating in the Chinese system. This chapter is then set to find out how this is done, what lessons may be learned, and how China will place itself in the eyes of the Norwegian business beholder in the future.

3.2.2. Data collection and selection of firms

There are currently, according to Innovation Norway's office in Beijing, some 150 Norwegian companies established in China. The variety is great, and among these there are many representative offices mostly playing a role in promoting sales and marketing to the Chinese market¹¹.

For the purpose of this study, it was necessary to learn in greater depth about the experiences and behaviour of the enterprises in question. Hence, the approach taken has been to interview a smaller sample of these firms. Further, a variation of sectors and size has been deemed necessary, to obtain a broader picture of the adaptation process and strategic choices of the companies.

The original list of companies was used to select a broader sample of companies which were approached by telephone and e-mail. As some were not reachable or had contact information that was not updated, a final selection was reached after omitting some that were negative to being interviewed.

In addition to the sampled companies, some additional interviews were planned to obtain additional information by persons or institutions that would be able to cast light wider lessons to be drawn from the presence of Norwegian companies in China. The full list of interviews is presented in annex 1. Most of the interviews were conducted in the Shanghai area, reflecting how Norwegian, and foreign, companies are concentrated in that area. However, location sites vary greatly, following mostly the pattern of the booming east coast areas, while a few have locations in mid-China with proximity to raw materials like for steel production or oil and gas.

Table 5 contains the key information about the companies in question. The companies include the Norwegian School of Management that was included to learn about internationalisation and innovation in education services as these become more globalised. The rest are commercial entities with various kinds of presence in China. The data obtained will be discussed in a more generic way to allow for an analytic approach to some key issues related to innovation in China.

¹¹ See list available from Innovation Norway:

http://www.innovasjon Norge.no/Internasjonalisering_fs/Utekontorer/Kina/Company%20name-4.htm

3.3. Old products in new markets?

The Swedish study referred to above (Schwaag-Serger and Widman (2005) illustrated how companies like Ericsson (telecom and mobile phones) with high R&D intensity establish R&D centres in China and other locations to support the product and technology development for the growing Chinese consumer market. The need to operate with high R&D intensity reflect such companies' need to adapt and develop according to specific features of these markets, and hence operate international or global systems of R&D activities.

The Norwegian companies operating in China, leaving aside the great number of representative offices to support exports, are mostly of another group. They are typically companies producing and delivering intermediate products and services to business clients as components to a final product. In fact, three groups may be identified, all of which rely on production and sale of their traditional products and services with a low degree of product adaptation:

- Companies that bring their technological skills and capabilities to China to take advantage of the abundance of raw materials. This concerns for example materials and oil and gas;
- Companies that produce and deliver their traditional products for the Chinese market, and see the growing market as the key rationale for operating in China. This will typically be suppliers of equipment to Chinese or foreign producers in China, like the automotive industry or ship yards;
- Companies that produce in China for their Norwegian operations or for their global clients outside China. In this case, a Chinese location is mostly related to the low cost production or availability of resources that are more scarce in Norway or elsewhere.

Representatives of the first group are StatoilHydro and Elkem. China is today the world's 3rd largest producer of oil and gas, with vast new oil discoveries and increasing production. Even though StatoilHydro's original rationale for the first establishment in China was giving advice to the Chinese government, the current objective is to take advantage of the resource base in China and participate in the increasing production levels, with the aim of producing some 100 000 BPD by 2015. StatoilHydro has a specific leverage for operating in the strongly regulated Chinese market, as the state owned oil company CNPC (a holding company) was partly established on the basis of advice from StatoilHydro, giving it some extra legitimacy on top of being basically state owned also. A 75% share in a producing field was bought in 1990, a field that is currently approaching the end of production.

Table 5 Norwegian businesses in China: Strategies and lessons

Company	Location/ year	Turnover/ staff	Strategic reason in China	Innovation pattern	Key challenges
StatoilHydro	Beijing/ Shenzen 1990, after initial phase	N/A 90 staff	China 3 rd largest producer, high competence	Currently low. Future with petro- universities, R/D centre	Nationalistic partners, low openness
Norwegian School of Management	Shanghai, Fudan Univ. 1995	15 mill NOK. Flexible staff	Globalising market for MBA, growing in China	Specialised programmes for expat-companies	Quality control according to Norwegian standards
Umoe Schat- Harding	Qingdao, 1999 (J.V.) 2004 (fully owned)	50 mill RMB	Low cost production for Asian market	Existing product for new market, R&D/design remains in Norw., coop with suppliers	Confidentiality, Legal enforcement,
Elkem International	Beijing/Sh anghai 1999	2 billion RMB, 600 staff	Growing market, potential for Elkem's techn.	R&D centres, collaboration with univ., applying prop.tech to Chinese problems	IPR, legal enforcement, speed and learning curve
Jotun	Jiangsu, Shanghai, Guangdon g 1995	1,4 billion RMB, 750 staff	Fast growing market	R&D lab for Jotun Norway, in Jiangsu R&D lab for custom adaptation, troubleshooting	Regulatory environment, industry not attractive for high skilled people, IPR.
TTS Marine	Shanghai, Dalian, Jiangsu etc. 1984, 1999	1 billion NOK, 400 staff (1500 in 2009)	Fast growing market in ship equipment	Customer driven, established engineering unit to support development work in Norway	Low engineering capacity in Norway, unstable regulatory environment
Det Norske Veritas	Shanghai, 36 offices, 1888 (!)	Turnover N/A, 700 staff	Extensively growing market	Home-based R&D, DNV Academy for training key personnel with clients/partners, Institutional innovation in regulatory environ.	Unstable, changing legal environment, diffusion of knowledge to engage with partners/clients, lack of knowledge of Chinese innovation system

DnBNOR	Beijing initial phase, Shanghai 2003	Turnover N/A 15 staff	Banking services for growing number of Nordic clients	Early mover in shipping and ship financing, innovative solutions to financing	Complex legal and tax environment, Extensive reporting to government(s)
DEFA Technology	Wuxi, Jiangsu 2005	Turnover N/A 70 staff	Low cost for European market, access to engineering,	Development work, initial contact with local univ., student projects, cooperation with suppliers, training	Poor interface with R&D system, too specialised skills, quality control, government and changing legal environm.
17 Group	Shanghai 1984/1994	Rep.office	Business network to exploit low cost, market opportunities	All development at home, sales through dedicated agent. Individual exits to establish own operations in China	Contractual relations with agent
Kongsberg Automotive	Wuxi, Jiangsu 2004	Turnover 200 mill RMB, 1100 staff after recent aquisition	Growth in Chinese automotives, competitive edge from European clients	R&D in Norway and Sweden, some development work for application/ adaptation, management training	IPR and know-how protection, learning curve important, complex legal environment, weak education system
Aker Kværner	Shanghai, Beijing, 1998	Turnover N/A, 370 staff	Growing market, sourcing of engineering capacity to AK global operations	Little R&D, this remains at home. Development work through engineering with clients	IPR and knowledge protection, low transparency in bidding, complex legal environment

Elkem's operations in China are quite different, and have great innovative impact. The overall size of the operation is already of some 2 billion NOK in turnover, with some 600 employees, of which 7 are non-Chinese. Elkem currently operates a carbon producing facility in central China that was bought in 1999. All Elkem's divisions are present, like solar, materials, metals, carbon, silisium and energy, and Elkem sees the Chinese and Asian market expanding and highly interesting.

The most interesting aspect of Elkem's operations in China, from an innovation standpoint, is the production of micro silica. Elkem has developed proprietary technology and know how to exploit the polluting dust from metals and materials plants to produce a highly valuable new product. Special equipment is installed to capture the dust at an early stage before reaching the chimney, and this has been deployed in Elkem's plans world wide. China's plants in this sector are, or have been highly polluting with great environmental damage. Hence, Elkem has entered into arrangements where the equipment is installed for free, with significantly positive environmental results, and in turn receives the waste (dust) for free. In this way, Elkem has

cleaned some 80 Chinese plants, giving rise to new business opportunities and with a positive contribution to a more sustainable industry in China.

The second group sees the growing Chinese market for intermediary products as the driving force. The typical case is the supplier of products for shipbuilding and auto industrial units in China. Both of these markets are growing with tremendous speed. For example, Jotun Coatings, which including a joint venture with Cosco has some 750 employees and a total Chinese turnover of some 1.4 billion RMB, sees its China operations as the fastest growing in the Jotun group worldwide. Both paint/coatings for the ship building as well as onshore construction are expanding. This is also the case for TTS Marine, a producer of equipment for ships and offshore rigs such as cranes and other deck machinery, with the number of employees expanding from one day to the next. With 400 employees today, TTS Marine expects some 1500 in 2009. About 25% of TTS total turnover is now generated in China. The key rationale for TTS Marine's presence in China has been the lack of available engineers in Norway. While TTS Marine is capitalising on the dynamic Chinese market for intermediary products related to shipbuilding, the company has also responded to the scarcity of engineering resources in Norway by establishing a dedicated group of engineers which solely works tasks generated by the Norwegian headquarters. In this way, TTS Marine is using its presence also to source engineering capacity for its domestic engineering activities.

Aker Kværner represents another approach to the peculiar market for engineering services in China. Until 1st January this market was severely restricted, as a specific license was needed to market such services in China. Hence, Aker Kværners' activity has until now been management services to petrochemical projects in China, a market which has grown rapidly in recent years. The current staff of some 370 people will see high growth rates in the future, especially as it will be possible to exploit the market for engineering. Further, with the great scarcity of engineering capacity world wide, Aker Kværner, like TTS marine, sees an interesting potential for sourcing of such capacity to Norwegian or global operations. The oil and gas market has been highly regulated and protected, and Aker Kværner has not had any role in this, contrary to what is the case world wide. However, with the increasing complexity of offshore developments, there has been growing interest from Chinese state oil companies, and it is estimated that the market potential will be significant. An additional function of the China operations of Aker Kværner is to expand the sourcing of low cost resources from engineering to other areas of products. The cost advantage of this implies that this will expand in the future.

Umoe Schat-Harding (USH) is another example of Norwegian or Norway-originated companies specialised in oil-and gas or ship-related equipment to reap the benefit of the rapidly expanding Chinese market. The company was based on former Chinese/Hong Kong joint venture in boatbuilding, and was acquired by USH in 2004. It produces life saving equipment for ships and offshore rigs, such as life boats and davits. The location in China is related to the wider Asian market, and has currently 190 employees with some 50 mill RMB in turnover. It has also an "after sales and services department based in Shanghai (a production facility, for reasons common to many of the other companies in the sample, and which will be discussed further in sections below).

The automotive market is expanding rapidly in China, a fact that Kongsberg Automotive in 2004 decided to take advantage of. Its recently established facilities in Wuxi outside Shanghai started with a yearly turnover of 12 mill NOK in 2005 and will reach some 200 mill NOK in 2008. Kongsberg Automotive is tightly integrated in the European automotive market, and

indeed receives a competitive advantage from participating in this market. Its European clients were positive to its possible location in China, and through contacts in Audi/Germany, Kongsberg Automotive's China operation was able to land an early contract with Audi/China. This example also reflects the nature of the market: The company delivers mainly to foreign or global clients in China, as well as directly to car producers. It should be noted that 75% of the market for cars are dominated by state owned companies (SOE). Kongsberg Automotive recently acquired an American automotive company of double size that has a firm presence in China. The result of this move will be China operations with 6 facilities and some 1100 employees, including R&D.

Among the second group, three companies in the services sector were interviewed, giving an interesting addition to the typical manufacturing firm. *Det Norske Veritas* (DNV) set up its first operation in China in 1888, and the presence fluctuated with the political and other framework conditions since then. Today DNV has a network of 36 offices throughout China, with approximately 700 employees. DNV experience a growing market for services in risk management and classification in line with the economic growth and investment boom in China. Such services are delivered across all main industrial sectors, mainly manufacturing, maritime, and energy. In addition to traditional services, such as classification and development of specifications for e.g. new ships, DNV sees a growing market in new software solutions. *The Norwegian School of Management* (BI) set up its activity within the Nordic Centre at the Fudan University in Shanghai in 1996. It delivers MBA programmes (part time) mainly for people employed in multinational companies to meet their need for training. The typical programme is run over 2 years, with 2 classes each year. New initiatives are developed to respond to more specific needs arising in certain areas, such as energy management. The activity is topped up with seminars, exchange of undergraduate students etc. Yearly turnover amounts to some 15 mill NOK, and the teaching services are sourced from BI in Norway and Fudan (of 15 modules, 9 are taught by BI, the rest by Fudan. *DnBNOR* offers banking services, and the activity set up in Shanghai reflects a key specialisation of the Norwegian banking sector in general and DnBNOR in particular: Ship financing for Chinese owners. However, the bank, operating as a full scale banking facility, offers services in areas such as offshore, logistics and energy as well. DnBNOR offers also an innovative approach to financing through offering loans in RMB through guarantees vis a vis a Chinese bank, thus circumventing restrictions that clients may have in obtaining financing in RMB directly. Another innovative practice has been the investment in competence about the legal framework for ships and shipbuilding in China. In fact, China has a dedicated legal institution for this sector, and normally foreign banks do not invest in this area. This has given DnBNOR a competitive edge vis a vis other banks that do not operate with full scale presence in that manner.

The third group illustrates the typical low cost producer, seeing China as a workshop for low cost production. Although many of the interviewed companies, as discussed, source engineering capacity and other procurement services to home based or global purposes, only one has taken the strategic approach to set up production facilities with a view to export back to the home base. This is the case with DEFA Technology, a company specialised in equipment for the automotive industry, such as engine heaters. The production facility set up in China (Wuxi like Kongsberg), serves all three business units (automotive, security and lighting), and has currently 70 employees of whom 40 are in administrative or technical functions. The main reason for setting up this facility has not so much been low production costs, although that plays a role as well. Rather, the key point has been access to engineering

capacity. However, initial contacts have been made with Chinese clients, and there is a growing interest within DEFA to expand in the Chinese market.

3.4. Ownership and alliances

Deciding on the entry mode for the presence in a new market is one of the key decisions to be made. In general, a company have a range of possibilities to choose from, as discussed briefly above. However, for the companies in question, there are basically two alternatives: A strategic alliance, e.g. in the form of a joint venture, or a wholly owned subsidiary.¹²

The difficulty of deciding between these two, and the options actually taken by the companies in question, tells a great deal about the challenges arising from operating in China and adapting to the Chinese system. The Chinese system is perceived as highly complex, with great uncertainties and risks. It is plagued by a wholly different way of doing business and relating to contractual arrangements. The lack of transparency makes it often imperative to ensure some structural solution that improves the interface with the system. Hence, for many foreign companies setting up operations in China, joint venture may be the preferred solution.

TTS Marine provides an illustrative solution to the adaptation to the Chinese system by way of a joint venture. In fact, TTS Marine currently has five operating units in China, one of them is a wholly owned subsidiary and the other four are joint ventures. A joint venture in Dalian produces cranes and other deck machinery, with an ever increasing backlog of orders. The same is the case for the joint venture in Shanghai, producing hatches for ships. On top of these two, and to reduce the risks related to scarcity of input factors such as steel, TTS marine has entered into two other joint ventures for steel production. The experiences from this mode of operation are positive. The contractual relations governing them are deliberately simple, leaving TTS Marine with board representation and an explicit right to fire the management if need be. The joint ventures are hence run by Chinese, whose motivations stem from the need to ensure reliable products and supplies to their ship building. An interesting observation by the local manager is that there has been a low degree of integration between the five different units, and that this has allowed a great degree of adaptation to local and other specific circumstances, explaining some of the apparent success. However, the downside to this is loss of synergy.

Jotun operates a dual system as well, with one wholly owned subsidiary and one joint venture with COSCO for marine coatings. The construction of this joint venture resembles the risk management inherent in effective China operations: Jotun retains full control over management and relevant knowledge and technology, while the Chinese counterpart takes charge of marketing and sales to the Chinese clients. Hence, the joint venture is a governance system for management of complementary assets for the Chinese market. Elkem has chosen a similar approach, retaining fully owned subsidiary operation combined with a joint venture with ERDOS for ferrosilicium in inner Mongolia. Up until now Elkem has been defensive when it comes to setting up joint ventures, but is considering a more expansive approach to sell core technology into such structures with a view to expand production volumes. BI entered into a joint venture with Fudan University to be able to operate on the basis of a well known academic institution and to ensure a mechanism for financial management in the

¹² A third may be the representative office, but that is mainly for exports without major operations in the focus country as such. An alternative version to this is related to clusters or networks that will be discussed separately below.

highly regulated Chinese environment. This alliance provided the basis for what has been an emergent strategy: The early stages were based on individual contacts and visions, leading to a “test case” that over time grew into a more strategic approach by BI, even though the China activity has remained loosely connected to BI’s core strategy (Ruud 2006).

However, many companies are sceptical to joint ventures as many experience significant knowledge leakages and confidentiality problems (this will be discussed in more detail in a later section). When it is not necessary for market access, wholly owned operations are chosen. Still, co-operative relationships are mostly necessary, and StatoilHydro represents a flexible approach to this: To govern the co-operation with PetroChina, a subsidiary of CNPC, a memorandum of understanding has been chosen that stipulates the basis for co-operation within as well as outside China. It relates specifically to technological co-operation for increased oil recovery, a field in which China has great expertise.

Umoe Schat-Harding prefers to be a fully owned company. One of the reasons is to ensure full control and safeguard the chosen strategy. Another is to more easily and quickly adapt to shifting circumstances when necessary. Kongsberg Automotive represents another case avoiding joint ventures, as their operation is wholly owned. With the new acquisition of the American company, the total Chinese operation, still wholly owned, will be significant. However, Kongsberg Automotive has an effective interface with its market through linkages with the European and global automotive industries, and can approach the Chinese market to their subsidiaries in China, as was the case with the initial contract for Audi/China. Aker Kværner and DEFA Technology, both active also in sourcing for home or global markets, are likewise negative to joint ventures, and in less need of it due to the market approach taken.

There is a pattern emerging out of this: Joint ventures are often perceived as necessary evils best to be avoided if they are not necessary to create an interface with the Chinese market. If chosen, they are structured with a view to protect knowledge and otherwise designed to simplify relationships between the two parties. However, a successful joint venture may open up markets for increased production and turnover, leading to balancing the trade-offs between this market access and knowledge leakage. On the other hand, companies choosing wholly owned subsidiaries exploit alternative routes to market access. This is evident for companies like DNV and Kongsberg Automotive. The former exploits relationships directly with domestic and foreign ship owners, while Kongsberg Automotive exploits the global network in the automotive industry. As much of the market for intermediary products is linked to foreign companies or joint ventures, this route has often proved a successful way to initiate operations in China.

The main obstacle to engage in joint ventures in China, lies at the heart of a firm’s innovation strategy. As will be developed below, know how and proprietary technology is perceived as being easily exposed to leakages and copying if not protected, and joint ventures may represent a risky way to operate in China. A key message coming out of the interviews is therefore that joint ventures created by Norwegian companies without earlier relationships with the partner are likely to fail. In many cases, Norwegian companies, new to the Chinese system, have had to establish partnerships through public offices that act as distribution channels for alliances and partners in joint ventures. Foreign companies are then typically given a Chinese partner of which there exists only rudimentary information. Many such joint ventures fail. Successful joint ventures, on the other hand, are established on top of earlier relationships through which trust and mutual understanding have developed.

3.5. R&D and innovation activity

China has evolved from a low cost manufacturing workshop of the world to become an ever more interesting location for R&D. In fact, the ongoing globalisation of knowledge and R&D makes China a promising location for globalised enterprises, as the combination of expanding markets with a growing science and technology system and improving skill bases lead to redefining the role of China in the perspective of foreign firms. The Chinese innovation system, as discussed earlier in this report, has developed rapidly as the Chinese government gives a great priority to the role of science and technology for the modernisation of China. Foreign firms have gradually set up R&D labs over the years, amounting to a current number of about 200. Although many of these are of small size, they represent a changing role of China in the global economic system, being more integrated in this system and offering more than only low cost.

The Chinese innovation system has improved in many respects over the past decades. However, there are many features of this system which makes it difficult for foreign companies. Many of those will be discussed below. The aim of this section is to describe and discuss how Norwegian companies practice innovation as such, be it R&D or invest in other innovative activities.

3.5.1. R&D labs

The overall pattern among the companies in question is that only a few have developed their presence to include R&D activities or to have established an R&D lab. Elkem has currently two R&D labs, one in Beijing and one in Shanghai, both focused on quality and applications. The Beijing centre has activities on fibre cement, a substitute to asbestos, and co-operates with the University of Beijing with the aim to train the staff in the University as well as receiving valuable knowledge in return. This is for the time being a small activity with only three employees. The Shanghai centre is larger with some 10 employees. Its activities are focused on micro silica, and will be expanded with the increasing attention to micro silica in China. This lab is well integrated and co-operates with Tsinghua University in Beijing as well as other research institutions. The R&D activity of Elkem is a case of hurrying slowly. The R&D activities are regarded as non-sensitive, as the core R&D activities for Elkem are still conducted in Norway or other places where copying and IPR infringement are not regarded as a problem. This is the case in China and makes Elkem defensive when it comes to investments in R&D. However, with the growing number of foreign (or joint venture based) R&D labs in China, there is also a growing accept of IPR. There are growing arguments for conducting R&D in China, such as the low costs of researchers and engineers, high skill levels and the ease of directing the results quickly into the value chain. But the current lack of protection has implications for innovation behaviour: Speed is important, innovation along the learning curve becomes an essential component of competitive advantage, and reduces the risks or consequences of copying. This means that a tight link between the R&D activities and commercial activities is of great importance.

Jotun is the other example of having developed the China presence as far as having included a significant R&D activity. Jotun experiences a fast growing market in China, and as mentioned, the China market is the fastest growing in Jotun. This has had implications for Jotun's China strategy: All key business functions are present in China, giving the China operations a fully

integrated business activity. This includes R&D, and a R&D lab was recently established. However, this lab is organisationally positioned with the corporate R&D function, and hence reports to the R&D director in Norway rather than to the China management. A reason for this is that the lab is not specifically linked to the China market development, but to Jotun's overall R&D needs, and will conduct R&D across all Jotun's activities. Jotun is the one of the multinational companies within the coating industry to have set up an R&D lab.

Jotun's R&D lab is still of modest size, with 8 people employed. However, significant growth is foreseen, with 13-14 planned for in a year, and some 20 in five years. The initial phase of the lab was concentrated around trouble shooting and very applied work. With Jotun's strategic approach taking impact, the lab has shifted focus to ordinary strategic and market oriented R&D as elsewhere in Jotun.

Jotun perceives many advantages with conducting R&D in China. Firstly, there is a need to adapt to variable customer demands and requirements across China, and this leads to R&D activities to ensure the success of this adaptation. Secondly, and related to this, the regulatory framework in China is rudimentary and immature. This again leads to more variable customer preferences as they have more room in which to develop their specifications. This feeds back into the need for Jotun to invest in customer oriented R&D. Some challenges are also evident from the point of view of Jotun: The costs of scientists are increasing, and while this is still not a major problem, it may be so in the future. Further, the scientific community does not see Jotun's industry as highly attractive, and there is a tendency for scientists to "brain drain" to other business functions like marketing rather than R&D. Competition for highly skilled human capital and scientists will increase, and the growing number of privately owned companies will be able to offer more attractive packages than Jotun, including stock options, for their core personnel. While supply of scientists to Jotun still looks manageable, there is a lack of experienced R&D managers, confirming the general problem in the Chinese innovation system of a lack of cross-disciplinary, innovative R&D management.

Jotun takes a strategic approach to the management of its China R&D resource. There is a very close co-operation with European based R&D labs. On top of that, there is a close co-operation with other Jotun R&D labs and exchange of scientific personnel between these, including a corporation-wide program for training scientists. Beyond that, Jotun is defensive like Elkem, avoiding co-operation with Chinese R&D institutions due to lack of protection and fear of copying and IPR infringement. Another reason is that Chinese universities are not yet sufficiently specialised for Jotun to gain much advantage. However, engaging with the Chinese system will be an issue, leading to a greater interface with it beyond the current one with suppliers for some development work.

StatoilHydro is an emerging case, where there is no R&D activity today. The collaborative relationship with PetroChina includes technological co-operation in the area of increased oil recovery in which China excels. However, given increasing production this will be an issue. In fact, an R&D activity will be formalised during the current year. A rationale for this is lack of qualified scientific staff in Norway, and the available competence in China is perceived as complementary to StatoilHydro's needs. Such a centre will complement the company's global R&D operations and co-operate with the main R&D centre in Trondheim, Norway. Present foreign oil and gas related companies in China do not normally invest in formal R&D activities. An exception is Schlumberger with a centre of some 350 people.

This pattern of modest R&D activity in China is in line with the general perception of foreign companies operating in China. The majority of the foreign R&D is related to high tech or science based industries, often linked to final demand, such as telecom and biotech. Most companies still retain their knowledge base at home, and only establish activities in China that are not too much exposed to copying. There are signs however, that this may change, also in the case of industries for intermediate, business-to-business products. This will in particular be so where the companies see the Chinese market growing in the future and where this market will contain incentives to invest in R&D, such as variable customer needs or new impulses and drivers coming from the Chinese development. The abundance (in most cases) of skilled people for scientific work makes future locations of R&D activity a promising route for many companies.

3.5.2. Networks and collaboration

With the modest activity in R&D as such, there are a number of different ways, small and large, in which the companies in question engage in innovative activities. The most prominent tendency is the increasing interest in collaboration with the Chinese R&D system. This does not include the national research organisation CAS (Chinese Academy of Sciences) which has gone through a dramatic reorganisation and downsizing during the past decade in attempts to modernise the institution and make it more relevant for industrial interests. Rather, the emerging interest is directed towards the universities. The rationale for this is two-fold: Firstly the companies have little knowledge about the research institute system like CAS. Secondly, the universities provide better opportunities for specialised knowledge and are more rich in opportunities. A case in point is StatoilHydro is considering future university co-operation, albeit with one or more specialised petroleum universities.

A similar argument resides with Jotun. The current activity of its R&D lab may in the future be complemented by university co-operation. The precondition for this is that universities become more specialised, again a confirmation of the current lack of relevance of the Chinese universities. DNV has likewise some emerging contacts with the university in Harbin, while its R&D activities are conducted and controlled through its centre in Norway. DEFA Technology has for some time tried to initiate contact and collaboration with the nearby university in Wuxi. However, it is been difficult to generate a constructive interface for institutional contact, confirming the fact that Chinese universities have little tradition and low capability in linking with industry, at least foreign owned. DEFA has on the other hand generated useful links through student projects. Several such projects have so far been completed, giving DEFA an effective mechanism for recruitment later on. The general impression of DEFA is that the university has a high scientific or academic level, but that this competence has not been applied towards interfaces with the industry or for applied, problem oriented R&D. Kongsberg Automotive draws much the same conclusion: The perception is that the Chinese higher education system is ineffective and delivers candidates with low levels of creativity and independent thinking.

A key mechanism for innovation and learning in innovation systems is the one of “user-producer relationships”. In other words, companies typically engage in innovative activities with suppliers and/or clients, giving the value chain a core role in innovative activities. Umoe Schat-Harding, which sees in the future some R&D activity in China, also has plans to establish activities in boat design. In this area there is scarce capacity in Norway, but also few available skilled people in China. The current solution is therefore to procure design services

in China. Other technical co-operation related to specific designs and specifications on key components is conducted vis-à-vis suppliers. Jotun has entered into collaboration with suppliers on development work, and sees this as a viable way to ensure sufficient innovation for the Chinese market as the suppliers are mostly other multinational companies operating in China. Other Norwegian companies with suppliers in China also co-operate with them for such purposes.

However, this user-producer relationship is also plagued with uncertainties concerning protection of knowledge. For example, Aker Kværner is very defensive in its relations with suppliers as specifications, drawings etc are easily copied. In fact this is also a problem with universities when they study other companies and initiates reverse engineering like any supplier would do. Kongsberg Automotive has removed the manufacturing information on key machinery in their production process. Managing the user-producer relationship in this context is therefore a challenging knowledge management task. This includes ensuring that the innovation and adaptation process is speedy and the learning curve steep to de-couple copiers and keeping them from gaining significant advantage.

The logic of establishing operations in China often becomes visible in the way complementary resources are being built. The Grenland Group, listed on the Oslo Stock Exchange, recently located in Shanghai, with the objective to growth with the Chinese market in the area of ship building and offshore rig construction. It already has some 20 engineers, and will expand this capacity to 200 within the year, as the availability of engineers in Norway is low. The innovative dimension of this is related to building complementary competence with the Chinese joint venture partner:

“There are very many ship engineers in China, so they have plenty of competence on floaters, be they ships or rigs. However, they do not have the corresponding competence in production and drilling systems, what we have.” (Managing director Terje Uthus, *Finansavisen* 1. February, 2008).

3.6. *The legal environment and government interface*

Appropriate framework conditions are part and parcel of an effective national innovation system. This includes the legal environment with the regulations, laws, and government institutions that companies will confront. From the OECD study on the Chinese innovation system as discussed earlier in the report, this is one of the key weaknesses. This weakness rests on the lack of traditions for “rule by law”, as conflict resolution in a broad sense has been a political and/or administrative matter. The law system is basically only 30 years old, and is steadily being expanded and developed. In many cases there is by now a good legal framework, for example for IPR, but the main problem that many companies face has to do with enforcement.

As has been alluded to already, there is among the companies a general perception that in case of conflict, for example IPR infringement, and this is brought to court, the chances that a foreign company may win the case is close to nil. This is especially so if the counterpart is a state owned enterprise (SOE). One great concern in this context has to do with the way the courts in China are set up and function. Over decades there has been a tradition that the judges are recruited among senior officers from the army. They have no legal training and will often perform nationalistically. The lack of legal training also lead to rudimentary decisions

whereby the rule of law is not necessarily enforced as a foreign company would expect. Most of the copying and imitation takes place in rural areas, linked to rather simple production. In these areas the judges are least competent, as they are appointed by the party, making the court system a property of the Communist Party.

However, the problem with the court system is becoming less problematic as China has to adapt to WTO standards and judges become better trained. In cities significant improvement has already been made. Further, as the most difficult problems related to copying and imitation concern simple production, it is easier to stop IPR infringement on niche products or intermediary products, as the Chinese will not lose many jobs through plant closures.

The companies' interface with the legal or governmental system can be discussed according to a set of dimensions:

Complexity: The most obvious feature of this system is its complexity. For example, a company like DnBNOR, like the others in various ways, has to provide governmental authorities with some 200 different kinds of reports with various schedules to four different authorities. Some of these are delivered often, some on a yearly basis. But it is a demanding system for most companies, not least to smaller one with scarce administrative resources. The innovative response by DnBNOR in this case is to develop a software to help rationalise this work load. Further, the governmental system is immature, and for many policy areas there is no dedicated ministry. This has for example the implication that StatoilHydro's governmental contact is with the state oil company, as there is no ministry of oil and energy. There are many restrictions concerning international transfer of payments, leading to both problems as well as innovative intermediary solutions such as DnBNOR issuing guarantees vis a vis Chinese banks to help capital flows to clients in RMB. The Norwegian School of Management (BI) is not allowed to manage the money flow (profits) on its own, leaving this to the partner Fudan University, but is looking into the possibility to set up a consultancy a legally registered business unit that will ease this money transfer. AkerKværner is experiencing a complex market related interface as data relevant for bidding on projects are mostly available only through clients and other contacts. Bids have to be delivered through public bidding offices with no contact with final clients. There are such bureaus in each district, 15 only in Shanghai. The system offers little transparency, and may invite corruption. For smaller companies these bureaus are real obstacles, but with effective networking they may also be of some support. The system is also often circumvented through informal contacts with clients or other partners.

Instability and flexibility: Another feature of the legal framework is its lack of stability. This is of course to a great degree explained by the fact that there is an ongoing process of institutionalisation of this system, changing the Chinese environment from an administrative system to one of rule by law. This means that laws, rules and regulations are constantly changed, adapted and expanded. New tax codes may be introduced overnight, demanding a high degree of responsiveness by the companies. The maybe most interesting feature being experienced by companies such as DEFA Technology and Kongsberg Automotive is that the legal system is negotiable. This is linked to the general problems of enforcement in China, as the laws and legal framework in general may be well developed, but enforcement may be highly random. In many cases, laws and regulations serve as a framework in which negotiations take place to arrive at an acceptable outcome for both parties. This is again linked with another feature of the system: The governmental representatives overseeing or applying the laws and regulations often do not understand them themselves, leading to an opportunistic, but also learning intensive interface.

Variability: There is a general perception that China is a highly centralised country, governed by a unified set of policies and laws across the country, with a powerful centre in Beijing. This is not the case. For example, the Ministry of Science and Technology, although a relatively small ministry, has only less than 300 employees in Beijing, but a much larger staff in the provincial governments' science and technology offices. The legal environment is structured similarly, with great variations between provinces. For companies operating throughout China, this environment makes local adaptation and learning an imperative. Metaphorically, the Chinese system resembles the European before the introduction of the EU internal market. DNV with some 36 offices in China is a case in point.

Uncertainty: The imperative in normal business operations is to minimize uncertainty. In China this has its specific challenges. As already mentioned, companies establishing operations in China and searching for partners to establish joint ventures, are required to apply for this in local governmental offices, which may distribute partners rather randomly. This ineffective interface leads to many breakdowns of joint ventures, as the matching process is devoid of information and trust. Another example is the demand for pilot installations by clients, often governmental or public, with the argument that before any purchasing decision can be made, the product or system has to be proven reliable. Elkem is often requested to set up pilots for certain technologies or equipment, but this is generally avoided as the pilots are also test beds for copying and imitation. A Norwegian software provider for system integration in hospitals saw the Chinese market as interesting and set up at pilot at a hospital in Beijing. However, the supplier has to carry the cost of this pilot installation, with the risk that as the system is proven reliable and effective, the client may choose to copy rather than buy. This raises the question of mechanisms for risk reduction through public support.

Adaptability: As stated above, the Chinese system of laws and regulation is an evolving system, with changes and adaptation being made in a continuous process of development with the end result to become compatible with global standards as laid down by WTO. Throughout this process, the Chinese government engage in policy learning from foreign sources alongside developing domestically originated solutions. The legal system for IPR, to make an example, is to a great extent built upon lessons from international IPR regulations. The presence of foreign companies also has an impact, not only on the business practices of Chinese firms, but also on the evolving system of laws and regulations. Although minor in itself, companies like Elkem, DNV and StatoilHydro contribute to this transfer process providing knowledge relevant for new regulations in China. In Elkem's case, there is a significant contribution to cleaner Chinese plants for carbon production, and there is increasing interest by the Chinese government in environmentally effective technology and training, leading to tighter regulations on emissions. Jotun also has a role in the significant impact on health and safety regulation. DNV has participated in a minor development project with the government in Beijing to help systems implementation in the area of risk management for environmental issues. As this activity relates to managing energy efficiency in partnership with a leading research institute, the results may in turn lead to upgrading of energy efficiency regulations that in turn develops the market for DNV.

In sum, the legal and governmental environment presents foreign companies with challenges. The dynamic nature of this environment implies that the companies have to be more flexible and responsive than in other countries. They often build specific resources or routines to deal with it, signifying a great deal of everyday innovation and adaptability.

3.7. Management practice, training and employee loyalty

A significant component of innovation systems relates to organisational issues and management practice. The absorptive capacity of companies is greatly influenced by the skills and competencies of their employees, as well as the investments in training by these companies to stimulate these skills and competencies. Organisational changes, management practice and training are seen as important innovation costs, however often overseen and poorly measured.

The foreign influence in this area is beginning to take on momentum. As many companies are concerned with quality with their suppliers, they are even promoting training and upgrading in these. A specific influence in this context is the collaborative project between the Norwegian business association NHO and its two Chinese counterparts CEC (Chinese Enterprise Confederation) and ACFIC (All China Federation of Industry and Commerce). This project is aimed at promoting tripartism, dialogue and improved, democratic working life in China. Leaving aside the problems of tripartism in a country that does not have independent trade unions or business associations, the project invests in generating practices of management, work organisation and training in line with the WTO and ILO rules and expectations. As such, it is one of many sources of influence of change in the Chinese system to organisational forms that are more conducive to innovation (see evaluation of this project in Hilsen and Brøgger (2005).

The overall pattern of influence is part of a globalisation of culture, as ideas and practices related to working life and the role of human resources are transferred across countries. Hence, China is in the process of becoming part of a broader capitalistic culture in which innovative behaviour is being rooted in working life practices in the company system. However, this is not a process of transmitting existing systems of practice, but adapting these systems to a local culture, as there may be significant cultural constraints and even taboos within the domestic culture that may render imported systems ineffective.¹³

For Norwegian, as any foreign, company in China, this is a crucial area of innovative adaptation. The cultural difference between the Chinese working life and western practices is vast. To ensure a low cost profile of the Chinese operations, most, if not all, employees are Chinese. In most cases only one, the top manager, or only a few expatriates, have leading positions, while the rest of the production and administrative staff is Chinese. The key challenge of the companies in question is the one of integration. This includes integrating the Chinese staff into the foreign companies' business practice, management systems and production modes. Some typical problems that often arise may illustrate this. Firstly, Chinese employees are not used to taking responsibility and providing individual judgements and assessments within the management process. The tradition of unified hierarchy in party-run companies is one of strict command structure and obedience. The Norwegian manager in TTS Marine illustrated this point when stating that he had reached an important step when his management staff openly presented disagreements with him. Secondly, the shop floor tradition in the west to seize responsibility through problem solving is not well developed. This has implications in particular for quality in the production process. Thirdly, the long

¹³ For en sjelden norsk studie, se Hammerstrøm, S.T. Kulturell tilpasning av human resource management i 100 prosent norskeide bedrifter i Kina. Masteroppgave i kinesisk. Institutt for kulturstudier og orientalske språk, Universitetet i Oslo, 2005.

standing tradition in China of regarding knowledge as something public and which may be imitated and copied breaks with the tradition of knowledge protection in modern industrial production. There is therefore a latent, and often a manifest, danger of recruiting employees that take part in leakages of knowledge, either while they are employed or through moving to another employer. Normal mobility of employees is mostly seen as useful in innovation systems, and this ensures knowledge flows in the system and a certain dynamic diffusion of knowledge that is not easily codified, but transferred through individual relocations. But for the individual company, there is a need to stem this outflow of knowledge and increase the loyalty of the employees to the firm.

The responses by the companies, many of them being global enterprises, is first of all to include the Chinese employees, in particular management staff, in their general or global training programmes. DNV has a global management training programme in which employees in all positions are included. This has increased loyalty and skills, and the turnover is very low. Umoe Schat-Harding has an internal training programme to ensure appropriate skills and competencies. Elkem has a global “Elkem Business System” that includes training, and Chinese talents and key personnel have been required to adapt to the Elkem practices through this system. It has given Elkem a short term cost disadvantage, but the strategic choice by Elkem is to “go by the book” to ensure a unified Elkem practice throughout its global operations. It is deemed to have improved loyalty and quality as well as safety, and the production operations are conducted with the same standard as in Norway. Jotun has a relatively high training budget with COSCO as an example having a budget of 2 mill RMB. These activities include both vocational, technical and management training. The company regards in particular the management training as important, and runs a programme of 15 days in total with some variations between junior and senior personnel. TTS Marine has not had a systematic training programme as such, but has invested in on the job training and mentorship for middle management to ensure a productive and effective management practice. However, a systematic programme is now being developed as the overall operations of TTS Marine in China experience tremendous growth. Aker Kværner has such a structured approach in place, and is particularly useful for young engineers, while older engineers have greater difficulties in changing from the former Chinese practice to the new and western. DEFA Technology has given priority to an on-the-job programme that includes cultural understanding, ethics etc, and employees are also sent to Norway to be better integrated in Norwegian practice and traditions. In sum, virtually all companies having production in China invest in training, not least to create a backbone of competence and skills in a market that is growing rapidly, and that leads to continuous recruitment of new personnel.

Secondly, some companies invest in having their employees included in MBA programmes, such as the one run by the Norwegian School of Management in collaboration with Fudan University in Shanghai. These are mostly 2-year management programmes costing 168 000 RMB per person, representing significant investments of those companies and individual concerned. In general, those companies having their employees participating in these programmes see them as useful additions to in house training for selected personnel. Further, some companies invest in specialised, company based MBA programmes developed and adapted by the BI/Fudan centre.

A further dimension of this is the obvious contribution of foreign management and organisational practices to the Chinese development. This does not mean that every foreign practice is for the better, but the import of western business practices and management models contributes to a renewal of the Chinese industrial system, and the long term spillovers may be

significant. It is generally reported that the Scandinavian management model is very positively received, with very low distance between the management and the shop floor. The openness and communication practices are well received, contributing to the loyalty that is much needed. This is also diffusing to other parts of the value chain, not least to suppliers, who experience a great pressure by Norwegian and other foreign companies to improve quality and introduce quality assurance and control measure and other management models to sustain such quality.

3.8. Clusters and networks

Dynamic innovation systems are typically an adaptive mix of competition and co-operation. Clusters and networks are key mechanisms in these processes, providing trade, learning and reduction of uncertainty. Clusters are often referred to as reduced scale innovation systems (OECD 2002), stimulation of networks through public support are often seen as an effective way to stimulate the development of clusters and knowledge flows inherent in such clusters.

Such collaborative structures also play a role in the way Norwegian companies approach China and possible establishment of operations there. This is all the more the case as smaller companies often do not have the resources to engage in advanced internationalisation like establishing operations in China. Hence, they often need a mechanism through which to learn, gain experience, and reduce uncertainty.

An interesting structure in this context is the 17 Group of Norway. This network of smaller companies producing marine equipment for the ship building industry was initiated by the Norwegian Export Council in 1984 as part of the Asia plan. Marine equipment had for a long time been a key export industry, and with the growth taking place in Asia, Japan and Korea most notably, a concerted effort was initiated by the Council. Thereafter, Japan and Korea reduced momentum, and China became the most interesting and promising target for exports and direct investments. When the 17 Group was established in China with a representative office, it was through links with the Chinese Ship Building Corporation (CSSC), and they even had a say in deciding which companies should be part of the 17 Group.

The initial 17 companies in the group received support from the Export Council, amounting to some 50% of the costs, from 1984 to 1991. After an intermediate period with no support but continuous activity by the group, the network was revitalised in 1996 with 12 members and marketing and sales through a dedicated agent in China. Due to some specific regulations, a mother company was set up in Hong Kong in 2001, controlling the representative office in Shanghai.

The functions of this network today are the following:

- Sales and marketing is channelled through the agent. This means that the representative office has a monitoring function vis-à-vis the agent.
- The representative office takes responsibility for more general marketing, exhibitions etc.
- The network's presence also takes charge of sourcing, i.e. finding suppliers for production located in Norway.
- It provides support and guidance for member companies with plans to establish firmer presence in China.

- The network provides contacts with final clients and ship designers with a view to ensure attention and interest for the group's products.

The fourth point above is important in this context. Through being part of the 17 Group, many member companies have over the years gained sufficient insight and interest to set up operations themselves in China. Thus, the group serves as a learning platform for eventual physical presence. The 17 Group is therefore constantly renewed with new members as some exit when establishing operations. This again relates to some specific rules governing the network:

- Companies within the network cannot be competitors.
- This means that they have distinctly different products.
- A member who establishes his own company in China, can still choose to be a member. Additionally they have the option to use the 17 Group's common sales agent in China. A member who establishes his own company in China, can still choose to be a member. Additionally they have the option to use the 17 Group's common sales agent in China.

The result of this dynamic evolution of the network is that only one member among the first group in 1984 is still member of the 17 Group.

Hence, the 17 group serves as a training and learning arena for the gradual approach by the companies to the growing Chinese market. They experience an advantage like many others in this industry: China imports some 70% of the ship's value from abroad, and the ship owners (mostly foreign) will typically not accept Chinese alternatives to the products delivered by the 17 Group.

A different kind of network, the NEEC (Norwegian Environment and Energy Consortium) was established in 2005, and comprises some 30 members, most of them established businesses in the energy and environment area¹⁴. The objective of this network is to support and promote Norwegian business development in China in the energy and environment area, and create attention to the vast opportunities in this market. Further, using the advantage of a significant network, the objective is to provide contacts with and access to governmental agencies deemed important for doing business in China. It organises seminars and workshops helping to diffusing important information and knowledge among the partners and beyond..

NEEC is driven by membership fees, but also supported by Innovation Norway, Ministry of Trade and Industry in Oslo, and NORAD, the Norwegian development agency. The activities of the network are co-ordinated by Innovation Norway's office in Beijing.

This network is of recent origin and impacts are difficult to assess. But it serves as an interesting way to organise Norwegian businesses to ease their approach to China in an area where China has vast challenges. With the support and role of the Norwegian government it may also help to create an effective interface with the Chinese authorities as this is important for the development of standards and technological solutions. A similar network that has been in operation for some time, INTSOK, has also set up a representative function in China, located in the offices of Innovation Norway in Beijing. INTSOK organises partners in the oil

¹⁴ <http://www.neec.no>

and gas industry, it was set up in 1997 as a public-private partnership with the Norwegian government. It has some 170 members and its main focus is to¹⁵

- Assess market opportunities and enhance the ability of the partners to compete in the global marketplace.
- Build relations between clients and government representatives abroad.
- Provide information about Norway's achievements in: enhanced recovery, cost reduction strategies and Health, Safety and Environment measures.

These clusters or networks provide some important lessons: Much of the efforts to gain market access and acceptance take place through “business to government” where the Chinese government is either a client or provides otherwise a key role in opening up projects, technologies and contacts. This means that such approaches may benefit significantly through support and backing by the Norwegian Embassy or other official links. This is easier and will have a greater impact if the business community is organised and includes the key players in a sector or technological area. Taking part in such networks may even prevent failures in doing business in China as they may represent knowledge that is important for the operation, or even influence the regulation or standard that makes a delivery of a certain technology or product feasible in the first place. Hence, penetration may be easier being part of a network, and public support by the Norwegian government through in particular Innovation Norway may be better focused and have greater impact.

¹⁵ <http://www.intsok.no>

4. Conclusions and implications

4.1. Summing up

China's economic and scientific revival has in many respects shaken the world. The country has over the past 30 years changed dramatically and has since opening up to the global community and inducing economic and other reforms grown by an unprecedented rate. China's integration in the world economy has added hundreds of millions to the global labour market, resulting in a dramatic combination of reduced returns to labour at the same time as returns to capital has grown significantly. China, among some other Asian countries, has attracted huge inflows of foreign direct investment, and seen exports and foreign currency reserves rise to the effect that the global trade and payment balance has shifted to an extent that many see as threatening to the global financial system. The development in China has not been even either. While the socio-economic inequality was at the lowest worldwide around 1980, it is now at the highest worldwide, threatening to disturb the internal political balance in China.

Science and technology received a key role in China's revival, and the science and innovation system has seen great investments as well as significant restructuring and change. Becoming a member of WTO also led to necessary improvements in the legal framework and other policy areas to accommodate the international regime for trade and investments. As China's economic and innovation system evolved over the past three decades, China first became the new workshop of the world, then later gradually also became a significant player in science and technology.

Many countries have experienced positive impacts from the rise of China. In some, this has led to contradictory developments such as inexpensive imports and abundance of capital coupled with loss of manufacturing jobs to China. The overall effects on a nation's economy have been linked to its economic specialisation. Norway has developed what could be termed the best possible terms of trade with China, as cheap imports has helped keep inflation down and China's demand for raw materials such as oil and minerals has generated great pressure on Norway's export products, leading to steadily growing trade surpluses and favourable balance of payments.

Foreign direct investments and establishment of foreign companies in China have as mentioned grown steadily, as China firstly became a low cost production site, then later a growing market by itself. The presence of Norwegian companies reflects this development. Some of them exploit the potential of producing to a low cost for their traditional markets outside China, reinforcing the export profile of the Chinese economic growth. However, many and in fact a growing number see the expanding Chinese market as the emerging rationale for their presence. In particular areas like shipbuilding and components for ships are expanding at breathtaking pace, leading to rapid growth in turnover in companies such as TTS Marine, producing cranes and other equipment for the shipbuilding industry.

The pattern of adaptation to the Chinese innovation system relates to uncertainty and instability. Finding a partner for a joint venture is a process in which the match making takes place through public bureaus, making it necessary for the Norwegian companies, and others, to develop relationships beforehand to ensure a partnership based on a minimum level of trust.

Most, if not all, companies leave their sensitive R&D activities at home or in other global locations as the Chinese system are plagued with imitation and copying. The companies often manage counteract the potential knowledge leakages that may take place through employee disloyalty through good management practices and training. However, there is a growing interest in increasing the R&D activities in China as the companies to a greater extent see the Chinese market as the key driver for their presence.

The challenges that the companies perceive as crucial to their adaptation, are also linked to the legal environment. Although the IPR policies and regulations have improved dramatically over the years and are now assessed as in line with those of most other countries, China fails on enforcement, leading to a reluctance by the companies to invest in significant R&D. Further the legal environment is complex in terms of the number of reports demanded on a regular basis by the government, and uncertain in terms of instability and the fact that regulations and enforcement of them are often subject to negotiation.

An illuminating observation in this study is that approaching the Chinese market and/or locating in China may be effectively supported by some cluster or networking configuration that helps the companies reduce their risks and learn, as well as helps Innovation Norway to organise more effective support. Individual companies with little experience and even no former partnership in China may well find themselves exposed to more risk than they prefer, as is confirmed by the relatively large share of joint ventures with “given” partners that fail. Co-operation among firms will help boost learning and better organisation of domestic resources.

4.2. Comparing with Sweden

Norway’s business experience with China is somewhat different from that of Swedish business. Schwaag-Serger and Widman (2005) studied the growing impact of China’s rise in the global economy on the Swedish economy and Swedish business. Their findings provide an interesting contrast with the case of Norway: Firstly, Sweden’s export specialisation is much in the same areas as the Chinese. Telecom and manufacturing including automotives are areas where Sweden generate significant export revenues. This means that the economic relationship between the two countries resembles more one of competition rather than complementarity, creating downside price pressure on exports from Sweden rather than higher prices as in the case of Norway. Secondly, the profile of Swedish businesses in China, along the specialisation in general, is more focused on final demand and consumption than the Norwegian profile. This means also that Swedish exports and also the ability to compete in the Chinese market directly is more difficult due to protective measures in such markets by the Chinese government. On case in point is the market for cars. Thirdly, Swedish industry is therefore also more prone to invest in R&D in China than their Norwegian counterparts. Fourthly, China is more likely to invest in Sweden as Sweden has R&D capability and human capital of great interest to the increasingly global Chinese high-tech industry.

To improve the terms of exchange between Sweden and China, Schwaag-Serger and Widman point to some additional options for Swedish entries in China. This includes the great potential in areas such as paper, steel and coal, more in line with Norwegian specialisation. They also refer to increasing potentials for services, including higher education.

The overall motivations for establishing operations in China have developed much like it has in the Norwegian case. Investing in the growing Chinese market represents an increasing component of the motivations while the one of being a part of a global strategy is declining (Schwaag-Serger and Widman 2005). It is likely that this will continue due to two factors: Firstly, the Chinese market size will continue to grow, including the consumer market. Secondly, China becomes more costly as wages and other costs are under upward pressure, giving a smaller role for the low cost motivation.

4.3. The public support system and implications for policy

The role of government and policy to support Norwegian companies innovative move to China should be discussed broadly within the context of globalisation and the overall impact on national policy for R&D and innovation. This report should give some stimulus to this discussion, as there is also to some extent a competition between western countries to ensure their respective businesses' successful move to China. Based on the material presented in this report, the following seems prudent to recommend:

- a) *More effective support through Innovation Norway:* It is a striking finding that one of the Norwegian companies interviewed for this report chose to, after careful examination, use the Swedish support agency in China when seeking advice for the process of establishing of its operations in China. Also other companies voiced the concern that the Norwegian support system is less effective than those of e.g. Sweden and Canada. Without having assessed this in more detail, the main problems seem to lie in the cost level as well as the competence and capacity that are present in China for these purposes. While many other countries exploit foreign aid resources, Norway has chosen to limit the role of foreign aid to support domestic businesses in their international operations. Evidence in this report suggests that more resources should be made available for this, and more consistent focus on presence and skilled back up for especially Norwegian SMEs. The perspective should not be to limit subsidies for Norwegian companies choosing to leave Norway, but rather to support, in a focused and effective manner, Norwegian businesses in their efforts to become more global.
- b) *Increase R&D collaboration:* Companies moving to China will or will not choose to set up R&D activities. This will be the result of their strategic assessment or the risks and benefits of doing so. However, many future industrial opportunities in China lie in areas that need new knowledge, technology and interfaces with governmental institutions in China. The human capital issue will be more important, and government-to-government co-operation may well be crucial to opening up some of the vast market opportunities in China. Norway has had a long history in scientific co-operation with China. In fact Norway was the first western country to enter into a science and technology exchange agreement with China, although the early stages should be seen as a broader cultural exchange. However, the current and future situation gives a broader rationale for public investments in R&D collaboration with China, as it is likely that China will offer much of the new knowledge developments in key areas such as energy and environment. It is therefore recommended that Norway should increase funds for scientific exchange, as well as consider to invest in a

collaborative R&D centre in China that has broad industrial backing and for which there is significant Chinese interest.

- c) *Clusters and networks*: Many of the Norwegian companies now successfully operating in China are already global firms with significant experience and resources to engage with the Chinese innovation system. However, globalisation is not only interesting or necessary for these companies. Smaller companies may to an increasing extent have much to gain by going global, not least in China with its new bearing on the global economy. The main lesson from this study is that many of these smaller companies suffer painful setbacks due to lack of experience, lack of contacts, insights and resources. Such problems may be compensated by being part of networks or clusters that promote a gradually increasing interface with the Chinese system, and thus provide a learning platform on which to, over time, decide on the eventual location in China. The 17 Group, NEEC and others are useful examples. Innovation Norway reports wide benefits from this, and sectoral systems in Norway may or should be encouraged to organise in such networks dedicated to the Chinese system. This is also the case for public support programmes such as Networks of Expertise, run by Innovation Norway. However, as the main benefit of such networks in China is to raise awareness among Chinese clients and the Chinese government, they should be national or in some way represent a significant part of an industry or sector to generate the attention of a Chinese counterpart.

References

Bjorvatn, K. et al: De gode hjelperne. Virkninger av utviklingen i Kina og India for norsk økonomi. CASE/SNF, Bergen 2006.

Chen, S. and Ravallion, M. (2004) "How did the World's Poorest Fare Since the Early 1980s?" World Bank Research Observer, Vol. 19. No.2.

Child, J. (1994). *Management in China during the age of reform*. Cambridge: Cambridge University Press.

Cooke, F. L. (2005). *HRM, Work and employment in China*. London: Routledge.

Grant, R.M. (2002) *Contemporary Strategy Analysis: Concepts, Techniques, Applications*. 4th edition, Oxford, Blackwell.

Hammerstrøm, S.T. Kulturell tilpasning av human resource management i 100 prosent norskeide bedrifter i Kina. Masteroppgave i kinesisk. Institutt for kulturstudier og orientalske språk, Universitetet i Oslo, 2005.

Hammerstrøm, S. and Lunnan, R. (2008) *Motivating Employees to Stay: A Study of Norwegian Companies in the Chinese Labour Market*. In: Hopsal Hansen, G., Lie, M. and Lund, R. "Making It in China", Høyskoleforlaget, Oslo (forthcoming).

Hilsen, A.I. og Brøgger, B. Evaluation of the NHO programme in Kina. Work Research Institute, Oslo, 2005.

Long, V. and Laestadius, S.: *Globalization of Knowledge Formation – The Role of China in Today's R&D Relocation*. Unpublished paper, 2005.

Lundvall, B-A. (2007) *China's Innovation System and the Move Towards Harmonious Growth and Indigenous Innovation*. In: *Innovation in China – Harmonious Transformation? Innovation, Management, Policy and Practice*. Special Issue. 2006.

Maddison, A. (1998) *The World Economy*. Vol. 1: A Millennium Perspective. OECD, Paris.

Mengkui, W. et al.: *China's Economy*. China Intercontinental Press, 2004.

OECD (2002), *OECD/China Industrial Linkages: Trends and Policy Implications*, OECD Directorate for Science, Technology and Industry

OECD (2005) *China*. OECD Economic Surveys, Paris.

OECD 2005: *Governance of Innovation Systems*. Vol. 1: Synthesis Report. Paris.

Ruud, G. (2006) The Choice of Internationalization as a Strategic Growth Area: Challenges and Possibilities. Master of Management thesis, The Norwegian School of Management, Oslo.

Sala-i-Martin, X (2007) Global Inequality Fades as the Global Economy Grows. Index of Economic Freedom. Heritage Foundation/Wall Street Journal. N.Y.

Schwaag-Serger, S. and Widman, E. (2005) Konkurrensen från Kina: Möjligheter och utmaningar från Sverige. Institutet för tilvextpolitiska studier. Stockholm.

Sigurdsson, J.: Regional Innovation Systems (RIS) in China. Working Paper no. 195.

Suttmeier, R.P. and Xiangkui, Y.: China's Post WTO Technology Policy: Standards, Software, and the Changing nature of Techno-nationalism. NBR Special report, Washington, Seattle. 2004.

Thompson, A.A. and Strickland, L. (2003) Strategic management: Concepts and Cases. N.Y. McGraw-Hill.

Zhu, C. J. (2005). Human Resource Management in China. New York: Routledge/Curzon.

Annex: List of interviews

China, 14-25 January, 2008

(Arrival in Beijing 13 January, **Hotel Novotel Xingqiao**)

Week 3, 14-18 January

Beijing

Monday 14 January,

Werner Christie, Innovation Norway
Innovation Norway Beijing
Suite 2205, The Spaces International Center,
No.8 Dong Da Qiao Street,Chaoyang District,
Beijing 100020
P. R. of China

Tuesday 15 January, 10.00

Egil Endresen, StatoilHydro, Beijing Representative Office,
28th floor, West Tower, Twin Towers
B12, Jianguomenwai Avenue,
Chaoyang District, Beijing
100022, P R China

Wednesday 16 January

Thursday 17 January

Friday 18 January 10.00

Sissel Thune Hammerstrøm, BI liason Office
220 Han Dan Road
Fudan University
Nordic Centre
Shanghai 200433
邯郸路 220 号复旦大学

Friday 18 January, 15.00

Goran Andersson, General Manager, Umoe Schat-Harding
Boatbuilding (Qingdao) Co., Ltd.
Member of Umoe Group
青岛城阳河套渔港码头
(at hotell)

Shanghai

(Hotel Broadway Bund Mansion)

Saturday 19 January, 10.00

Tom Preststulen, Elkem International,
22 A Pu Fa Tower, 588 South Pudong Road, 200120 Shanghai
上海浦东南路 588 号浦发大厦 22 楼 A 座

Week 4, 21-15 January

- Monday 21. January, 10.00 Morten Borgos, R&D Manager, Jotun Coatings, China
20F, Jiushi Building No. 28
Zhong Shan (S) Rd.
Shanghai,200002,China
- Tuesday 22 January, 10.00 Arne Knutsen, TTS Marine, 433 Gao Xiang Huan Road,
Gaodong Industrial Park, Pudong New District, Shanghai
200137
浦东新区高东工业园区高翔环路 433
- Tuesday 22 January 15.00 Thomas Vogth-Eriksen and Paul Campbell, Det Norske Veritas,
House no 9, 1591 Hong Qiao Road, Shanghai 200336
虹桥路 1591 号虹桥迎宾馆 9 号楼
- Tuesday 22 January 20.00 Dan Moloney, Aker Kværner, Deputy Project Director
Dow Corning 3rd Pillar Project 道康宁项目
27F, Times Square 时代广场 27 楼
No. 500 Zhangyang Rd, Pudong, Shanghai, China, 200122 中国,
上海浦东, 张杨路 500 号, 邮编 200122
- Wednesday 23 January 11.00Lars Berge Andersen, Chief Representative, Wikborg, Rein &
Co., International Law Firm
Suite 327, 12 Zhong Shan Road E.1
Shanghai 200002
Peoples Republic of China
中山东一路 12 号 327 室
- Wednesday 23 January, 15.00 Espen Lund, DnBNOR, Room 901, 9F Central Plaza,
381 Huai Hai Zhong Road, Shanghai 200020
上海淮海中路 381 号中环广场 9 楼 901 室
- Thursday 24 January , 11.00 Robert Ramner, DEFA Technology,
"No.11, XiKun Road
No.83-C Block Wuxi National
Hi-Tech Development Zone
Wuxi Jiangsu Province
China, 214 028
江苏无锡新区 83-C 地块锡坤路 11 号, 214028
- Thursday 24 January Bent Wessel-Aas, Kongsberg Automotive Ltd. (Wuxi)
No 30-32 Xi Kun Road
Wuxi-Singapore Industrial Park
Jiangsu Province, 21 40 28
China

Friday 25 January, (10.00) Martin Nickelsen, General Manager, 17 Group of Norway Ltd.,
Shanghai Representative Office
Address: Room 3102, 31/F, Shanghai Universal Mansion
168-172 Yu Yuan Road, Shanghai 200040
上海市愚园路 168-172 号 3102 室, 200040

Additional interviews:

Bjørn Villadsen, Project manager, NHO, China project.

Kjell Stenstadvold, Norsk Hydro ASA, Oslo.