Dilemmas of U.S. Export Control of Technology Transfer to China

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Technology transfer from the U.S. and its allies to China is basically a combination of West-East and North-South characteristics.[1] China's "unbalanced" development strategy for the past several decades has resulted in some technologically advanced military fields, such as strategic nuclear forces, and a strikingly backward civilian sector. This uniqueness confounds U.S. decisions on export control of potential military technology to China, whereas western Europe and Japan can take full advantage of the economic opportunities beginning in the late 1970s. The U.S. relative disadvantage in economic terms as compared with its allies in dealing with China is hypothesized to be more serious than when dealing with the Soviet group. Meanwhile, the U.S. policy to ban some critical technologies to China may also be eroded by China's concerted efforts to get access to them and the informal channels rooted in the extensive Chinese network in the U.S. science and technology community.
Frameworks for Analysis

U.S. export control of potential and explicit military technology, whatever it is embodied in, to China consists of policy and implementation dimensions with respect to international technology transfer, which in turn pertains to technology innovation and the context of national development on both sides.

For technology transfer to occur, there must be some convergence of corresponding needs and resources from the concerned parties. These needs and resources are the manifestation of individual countries' whole systems which include mutually interactive value, socio-economic and technological subsystems with the last one directly dealing with the natural environments which reciprocally affect the above three subsystems. Responding to needs and making use of resources under some kinds of external influences, a country carries out a variety of technology innovation and transfer activities. The different outcomes which depend on the system structure, function, strategy and implementation, and the natural resources available then become incorporated into the original system. In fact, these arguments can also apply to country group, country, industry or firm levels.

In technology transfer, there are several generic contexts: West-East, North-South, West-West, etc. The main issues in the West-East context are the large scale confrontation between the U.S. bloc and the Soviet bloc in political, ideological, military and even economic arenas. In North-South context, the key challenges include the modernization of backward economy and the shortening of gap between advanced and poor countries.

The reason why the acquisition and control of advanced technology has become of strategic importance is that modern advanced technology
can contribute greatly to both economic and political strength. This rationale underlies most international technological competition.

**Basic Property of U.S. Export Control of Technology to China**

The U.S. export control in essence is an attempt to prevent potential or explicit military technology from flowing into potential or explicit adversaries. COCOM is a coordination mechanism particularly designed for the U.S. and its western allies to deal with the trade with East bloc which may contain “militarily critical” technology. The essential task is to weigh the economic costs of control against the security risks of non-control. The basic causal analysis in the U.S. export control is briefly shown in Exhibit 1.[2] The positive causal loops tend to intensify the control whereas the negative loops tend to reverse. The real situations are the accumulation of various effects caused by each component over time. From this exhibit it is evident that the competitive supply of technology from other nations and U.S. R&D investment sponsored by economic muscle also play a crucial role.

**Exhibit 1**

So far as U.S.-China relations are concerned, both began trying to establish some kind of alliance right after the Soviet invasion into Czechoslovakia in 1968 and the border military clashes between the USSR and China in 1969. Since then China gradually became a strategic card against the Soviet Union in the U.S. hand; and vice versa. And China, though still an “East” country in terms of its socialist system, was treated separately from the Soviet bloc by the U.S. and its western allies. Because the average technological horizon in China is much lower than that in the West countries, the West-China technology transfer is
thus a blending of West-"East" and North-South characters. In the civilian sector, China is a typical less developed country. In the military sector, however, China owns some leading edge in certain strategic nuclear forces over many U.S. and Soviet allies. This big discrepancy within China often confounds U.S. decision making.

If China applies the imported advanced technology for economic development, there is no need to worry about its threat at least in the foreseeable future because of its far lagging economy to date. Even the increasing competitiveness of its low-end products can mostly be accommodated at the expense of other developing and newly industrialized countries. So the adverse effects can be very slight and far exceeded by the anticipated tremendous commercial benefits. Nevertheless, if China imports technology directly or indirectly for military sake, then the marginal effects may be substantial or even critical and may threaten U.S. hegemony in Asia in the near future. Moreover, the close U.S.-China military relations may also exacerbate U.S.-Soviet relations and damage the West-East arms control. This dilemma, however, is not taken for granted by most U.S. allies because they have already lost their political and military hegemony in the Asian area and they, unlike the U.S., do not possess such advanced strategic military technology as to significantly change the military balance or deteriorate the relations with the Soviet Union. Therefore, they can rather freely take full advantage of the economic opportunities created by the U.S. and the China's open door policy without reservation and hesitation. The dilemma faced by the U.S. is illustrated in Exhibit 2.

Exhibit 2
Nuclear Power Technology—A Typical Example[3]

In the early 1980s, China announced an ambitious nuclear power construction program aiming at supplying electricity to its coastal areas which became highly prioritized under the new economic development strategy beginning in the late 1970s. In this program, China adopted a scheme combining self-development and technology importation. Its intent supposedly was to create the synergistic effects from both approaches and to strengthen the bargaining power with potential foreign suppliers.

In the Shanghai Project, a 600MW plant construction, the Chinese mainly used the technology derived from their experience in constructing more than four nuclear-powered submarines. In the Guangdong Project which consists of several 1000MW PWR plants, they imported many components and technologies from the U.K., France, West Germany, Japan, etc. with a goal to attain 80% self-reliance in the fourth plant by the year 2000.

While all these advanced countries along with the Soviet Union were ready to provide the technology the Chinese could financially afford, the U.S., from which the key PWR technology was originated and to which the above western countries were still paying royalties, failed to take active action. The major reason is that the U.S. wanted to maintain its global stance in nuclear nonproliferation, and to execute the policy against the diversion of nuclear energy technology to military use.

In view of China's records of supplying spent fuel to South Africa and Argentina, the evidence of China's assistance to Pakistan in nuclear weapon development, and the possibility to transfer the sophisticated nuclear reactor technology to improve China's submarine propulsion system, the U.S. extreme prudence in this case is understandable. Besides, China consistently rejected the U.S. request for rigorous on-site
safeguards, reprocessing consent rights and end-user conditions, because they were regarded by China as an infringement of national sovereignty. As a result, the nuclear cooperation agreement between these two countries was not signed until recently when China promised not to reexport spent or reprocessed fuel and supported publicly the nuclear nonproliferation principle.

Throughout the past few years, the U.S. nuclear industry, which was desperately in need of business contracts, has lost big opportunities in China's nuclear power program, and China's acquisition of nuclear power technology was not constrained at all because of the existence of multiple "enthusiastic" foreign technology sources.

**Encounter of Two Different Systems**

The above mentioned case also has some implications about the encounter of different systems. In the face of challenges which are intensely ideological and heavily dependent on the perception of potential adversary's intention and threat, such as the military connection with China, different departments inside U.S. government normally hold different positions, and the final compromises are usually fluctuating. On the contrary, most governments of U.S. allies only take economic factors into account when dealing with China. Besides, these governments are promotional rather than regulatory in their economic role, as compared with their U.S. counterpart, and thus more closely linked with their business communities. Therefore, the U.S. economic response, which is almost entirely executed by the private sector, is impeded in a relative sense.

By contrast, China's system in dealing with these kinds of military and strategic issues is centrally controlled and coordinated despite some evidence of low efficiency in the implementation stages.
In terms of value, socio-economic and technological subsystems, China's military development, except the "People's War" strategy, has for the past four decades been following the Soviet's track, and, in some sense, is more extreme when its very difficult economy is taken into consideration.

Because of the miserable modern history partly caused by foreign invasion, nationalism in the present China is extremely high. So the military investment, especially the development of offensive nuclear weapons which the Chinese believe will provide a deterring shield against the superpowers' threat, always has a very high priority even at the sacrifice of economic development. Moreover, in China there is little balance of power. The executive branch in general and the central government and the Communist party in particular have overwhelming authority over major national decisions. Under this system, the military establishment has the preferential right to recruit necessary national resources and to form large scale mission-oriented task forces isolated from the outside world and exempt from political interference which is "institutionalized" in the non-military sector. Consequently, some focused fields within the military sector have far advanced technology which can by no means be inferred from the apparent backward situations as commonly seen in the civilian sector.

After the abrupt withdrawal of Soviet technical aid in 1960, China decided to develop its nuclear forces on its own feet. And it became China's major objective to deter the Soviet aggression and intimidation, and to secure a strategic retaliatory attack capability since the Soviet Union became its No. 1 enemy. Up till now, this strategy has given China significant deterrence power despite its numerous deficiencies and far smaller strategic nuclear arsenal relative to the U.S.'s and the Soviet's. [4]

Referring back to the previous nuclear power case, as nuclear
technology and industry are of strategic importance to China, China has special steering and coordinating mechanisms to facilitate the policy making and implementation across military and civilian departments. By the same token, China has recently established several so-called “leading groups” in the State Council to push forward multi-departmental strategic programs such as science and technology, electronics, and foreign investment. This design is to overcome the strong compartmented tradition ingrained deeply in the dinosaur-like bureaucratic machine.

China’s Recent Adjustments in Development Strategy

The formal launching of the Four Modernizations Program was around 1978.[5] This Program was to rectify some very serious development imbalance resulting from the aggravated productivity (i.e., intensive development) for more than two decades, in spite of the fact that China’s strong commanding system rather successfully mobilized resources (i.e., extensive development) and redistributed limited wealth and opportunities.

In this new endeavor, science and technology was one of the several central foci in the domestic and foreign policy agenda of China’s top leadership. Yet about two years after the open-door policy, four major errors in importing foreign technology were reported. They were:

- excessive reliance on whole plant and equipment imports,
- widespread duplication of imports,
- tendency to import items without adequate knowledge of their operation or maintenance, and
- failure to sufficiently understand imported technology and to diffuse it.[6]

From then on the new emphasis was placed on intangible forms of technology. Exhibit 3 shows the transition of China’s technology and plant
purchase between 1972 and 1984. The first drastic expansion around 1978 marks the beginning of the Four Modernizations Program; and the contraction in 1981 reflects the adoption of the new policy.

Exhibit 3

In 1982, China articulated seven stipulations regarding its policy of importing technology. These stipulations, though strong in tone, appeared quite consistent with the attempts of many Third World countries to increase their bargaining leverage in the negotiations with industrialized nations.

In addition to the technology importation from abroad, China is now trying to facilitate the other three types of technology transfer:

- from coastal areas to interior areas,
- from R&D units to production units, and
- from military sector to civilian sector.

In all, China still maintains its basic policy of emphasizing self-reliance and indigenous capabilities. With respect to the acquisition of foreign technology, China tries to diversify the sources and unconditionally refuses to accept the end-use controls of the imported technology. Moreover, China is now incorporating bilateral government-to-government cooperation and commercial relationships. The former is usually seen as a necessary condition for the expansion of the latter. Examples include the sales of French nuclear energy equipments, and Japanese and French participation in off-shore oil exploration.

China's Present Military Technology Targets

Regarding military development, China's decision to curtail military growth for the sake of economic development was initially implemented
in the 1971-72 time period. Estimated spending for the strategic offensive forces, however, was steadily increasing since 1979. Besides, more than half of the military R&D expenditures were estimated to be spent in nuclear weapon programs. In 1982 there was evidence that China succeeded in MRV (multiple reentry vehicles) and simulated battlefield nuclear warfare in large military exercises. It is also believed that China is developing tactic nuclear weapons.[8] Nevertheless, China is still incapable of launching much of an immediate retaliatory attack due to the weakness in information technology. Therefore China's present military modernization targets are:

- early warning radar,
- intelligence and reconnaissance satellites,
- more secure command and control equipments, and
- better computers and other instrumentation in production and operation of nuclear weapons.[9]

In broad technology areas, the following items have been focused by China as of top priority: electronics, computers, special alloys and materials, nuclear energy, petroleum exploration and exploitation, energy conservation, biotechnology, aeroengine, avionics, communications, and transportation.[10] In this list, some are definitely also for military purposes.

**Conclusion -- U.S. Policy and Implementation Dilemmas**

Despite the relaxation of U.S. export controls in the late 1983 and the following year's three times growth of "high-tech" trade with China from 1983's US$1.1 billion (Asian Wall Street Journal Weekly, Dec. 31, 1984, p1), the U.S. is still at a disadvantageous position relative to its western allies.

As a global superpower and the "big brother" of the western world,
U.S. has to consider many political and military implications, whereas West Europe and Japan are much more sanguine about China's intention and thus much less constrained in their technology transfer policy towards China. In reality, they are much more concerned about the Soviet threat and tend to see China as a military counterweight against the Soviet Union rather than a potential adversary. Japan, taking full advantage of its proximity to China, appears to have a consistent national strategy vis-a-vis China. It has been establishing a broad network of ties with China and willing to provide certain high technologies in return for the access to China's natural resources and energy supplies. All these suggest the wider gap between the U.S. and its allies in dealing with China than with the Soviet Union. Nevertheless, China is still most interested in U.S. electronics, computer and military technology, therefore still leaving tremendous economic opportunities for the U.S. should U.S. non-economic considerations be consistent with its economic ones.

As to China's relations with the Soviet Union, the recent growing cooperation between the two parties is seen as of minor importance. It is unlikely that China will look to the Soviet Union for major technology items, unless the West is perceived to be intransigent with respect to technology sales.

Presently, China's technological connection to the U.S. continues to be the largest and most active in its proliferating international activities. The two countries have signed 26 protocols for science and technology cooperation. About 17,000 students and scholars from PRC are now studying in the U.S., most of whom are in science and engineering fields with 30% being enrolled in a score of U.S. top engineering schools.[11]

Because of the huge amount of Chinese Americans, China in effect has an extensive informal network in addition to the formal and institutionalized channels for the flow of technology back to China. It is
said that the Chinese do not use money to buy banned technology as USSR's KGB agents usually do, therefore the investigation into China's clandestine activities in the U.S. seems to be more difficult.

According to the Federal Register in November, 1983, technology to be transferred to China can be denied if it makes a demonstrable contribution to one of the following six mission areas:

- nuclear weapons,
- nuclear delivery systems,
- anti-submarine warfare (ASW),
- electronic warfare (EW),
- intelligence-gathering systems, and
- power projection/air superiority capabilities.

Nevertheless, in the light of China's extreme interest in most of these technologies and concerted efforts to acquire them, and the many decision-making and implementation confusions on the U.S. and West side, it seems not very optimistic for U.S. government to achieve its pronounced objectives as mentioned above.

Endnotes

[1] "China" in this paper does not include Taiwan.

[2] The building of this diagram follows the rules of discipline in "System Dynamics." The "+" sign means the stronger (or weaker) the preceding factor the stronger (or weaker) the follower factor. The "-" sign refers to the opposite situation.


[4] For a more comprehensive discussion, see Sutter, R. G. "Chinese

[5] The Four Modernizations Program was first announced by the late Premier Zhou Enlai in 1975, but was not actually executed until 1978 because of the death of Zhou Enlai and Mao Zedong in 1976 and the following political turmoil.


[7] These stipulations were spelled out in 1962 by Xu Deen of the China National Technical Import Corporation.

[8] All the relevant information here was estimated by U.S. Department of Defense. Also see Parris, E. "Chinese Defense Expenditure, 1967-83" in U.S. Congress Joint Economic Committee, *op. cit.*


[11] These numbers were estimated by Prof. Denis F. Simon of MIT Sloan School.
Exhibit 1. Major Causal Relationships in U.S. Export Control of Military Technology
Desired Economic Benefits

Pressure to Ease Control

Desired National Security (and Hegemony) Level

U.S. Export Control of Potential and Explicit Military Tech to China

Supply from Other Sources

China's Military Strength

Checks on Soviet Expansion

Soviet More Military Investment

Soviet Threat

Potential Threat to U.S.

Mutual Trust & Cooperation Between U.S. and China

U.S. National Security (and Hegemony)

Exhibit 2. Major Factors in U.S. Export Control of Military Technology to China
Exhibit 3.

**China's Plant and Technology Purchase (1972-1984)**

<table>
<thead>
<tr>
<th>Years</th>
<th>Total (US$ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>0.12</td>
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<tr>
<td>1973</td>
<td>1.49</td>
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<tr>
<td>1975</td>
<td>0.37</td>
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<tr>
<td>1976</td>
<td>0.20</td>
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<td>1977</td>
<td>0.20</td>
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<tr>
<td>1978</td>
<td>3.41</td>
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<td>1979</td>
<td>3.73</td>
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<tr>
<td>1980</td>
<td>2.03</td>
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<tr>
<td>1984</td>
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*Source: Japan-China Economic Association, 1985*