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Not a 'Wal-Mart', but an 'Imports-Exports Enterprise': Understanding the Nature of the A.Q. Khan Network

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by Bruno Tertrais

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Introduction

Much has been written about the A.Q. Khan network since the Libyan “coming out” of December 2003. However, most analysts have focused on the *exports* made by Pakistan without attempting to relate them to Pakistani *imports*. To understand the very nature of the network, it is necessary to go back to its “roots,” that is, the beginnings of the Pakistani nuclear program in the early 1970s, and then to the transformation of the network during the early 1980s. Only then does it appear clearly that the comparison to a “Wal-Mart” (the famous expression used by IAEA Director General Mohammed El-Baradei) is not an appropriate description. The Khan network was in fact a privatized subsidiary of a larger, State-based network originally dedicated to the Pakistani nuclear program. It would be much better characterized as an “imports-exports enterprise.”

I. Creating the Network: Pakistani Nuclear Imports

Pakistan originally developed its nuclear complex out in the open, through major State-approved contracts. Reprocessing technology was sought even before the launching of the military program: in 1971, an experimental facility was sold by British Nuclear Fuels Ltd (BNFL) in 1971. In 1974, Pakistan signed a contract with the French company Saint-Gobain Techniques Nouvelles (SGN) for the sale of a large reprocessing plant at Chashma, which was to use the fuel irradiated at KANUPP.[1] Nonproliferation concerns led the French to suggest a change in the design that would make Pakistan unable to produce weapon-grade plutonium. Islamabad's refusal led Paris to stop the execution of the contract in 1978. This did not prevent European firms to participate in the Pakistani nuclear program. In fact, SGN engineered the pilot reprocessing plant at PINSTECH (“New Labs”), while Belgonucléaire designed the overall building and built a fuel refabrication laboratory.[2] However, the 1974 Indian test led Western countries to be much more cautious about their nuclear exports to Pakistan.

This is one of the reasons why Islamabad launched a second, secret nuclear program in the mid-1970s which was to use the HEU route. The launching of this program saw the beginning of a massive campaign of imports from Western firms. Equipment sought by Pakistan included key elements for centrifuges (maraging steel, high-frequency inverters, high-vacuum valves, scoops pre-forms, bottom bearing pre-forms...). But the imports network also sought many elements for the plutonium program (hot cell manipulators, reprocessing equipment), as well as components meant for the nuclear weapons themselves (high-speed electronic switches). Measuring

equipment was also actively sought. Pakistani imports also included nuclear materials and metals. Imports ranged from full-scale installations to subcomponents.

Some of the most significant of these imports included uranium conversion facilities (CES Kalthof GmbH, Germany, late 1970s); several thousands tubes of maraging steel (Van Doorne Transmissie, Netherlands, late 1970s); a yellowcake production unit (Société d'études et de travaux pour l'uranium, France, late 1970s); a reprocessing facility (Saint-Gobain Techniques Nouvelles, France, and Belgonucléaire, Belgium, late 1970s); a heavy water production facility (Belgonucléaire, late 1970s); and a tritium production facility (Nukleartechnik GmbH, Germany, late 1980s).

At the same time, Pakistan resorted to China as an alternate source of imports. Chinese assistance developed after ZA Bhutto signed a bilateral agreement to that effect at the occasion of a visit to Beijing in late May 1976. China helped Pakistan overcoming some of the difficulties they had in mastering enrichment technology. It supplied uranium hexafluoride to Pakistan, as well as a HEU-based nuclear weapons design.

The imports network was originally a "Khan network," but not in reference to A.Q. Khan. A different individual was running the show: most imports from the West were supervised by Munir Ahmad Khan, the head of the Pakistani Atomic Energy Commission and arguably the true "father" of Pakistan's bomb. One of the network's key operatives, and probably its chief operating officer for Europe was SA Butt, a physicist turned diplomat, who was assigned to various embassies. The network began operating in earnest in 1976. Having just returned from the Netherlands, A.Q. Khan soon played a crucial role, but only in the management of imports related to the centrifugation technology. SA Butt managed both the uranium-related and plutonium-related imports.^[3] He remained in charge at least until the late 1980s.

The imports network's *modus operandi* included a combination of several elements that ensured its success and longevity. Pakistan resorted systematically to the use of its embassies abroad, and often to Pakistani-born foreign nationals. It paid more than the market value of the items purchased. The Pakistanis played smart and were always one step ahead of the legality. As exports controls began to be reinforced in the late 1970s, they purchased individual components rather than entire units. After, they often learned how to reproduce the parts. Pakistan also sought to import "pre-forms," which are not necessarily covered by exports controls. Besides classic tricks such as multiple buyers, multiple intermediaries, front companies and false end-user certificates, Pakistan used more imaginative tactics: for instance, it sometimes hid a critical component in a long list of useless material. It also often limited its "shopping lists" to a few samples, in order to learn how to reproduce them. A British intelligence report stated in 2003 that no less than 95 Pakistani organizations and government bodies, including diplomatic posts abroad, had assisted in the country's nuclear imports.^[4]

The Pakistani *modus operandi* was very similar from the one used by Iraq in the 1980s. Baghdad then resorted to an increasingly refined imports strategy which heavily relied on multiple fake companies, and sought at least two sources for any given material it needed. Iraqi embassies were heavily involved. Note also that several individuals and companies (German and Swiss in particular) were selling to both countries. One difference, however, is that the Pakistani network was more centralized than the Iraqi one.

The success of the imports network was not only due to the high degree of Pakistani know-how, but also to the active cooperation of Western firms. Pakistan took advantage of inadequate exports control in light of the appetite of Western firms to sell technology abroad. The first IAEA guidelines published in 1974 were very limited. It was a grey market rather than a black one. Many industrialists reasoned that "if we do not do it, others will" and deliberately violated the law. Others believe that Pakistan would not be able to use the components for military usage. Many just did not realize that they were helping Islamabad to get the Bomb—or did not want to know.^[5]

Finally, some of the main figures involved in Pakistani imports have stated that they were very deliberately helping the spread of nuclear technology, arguing that it would make the world more secure.^[6]

European firms were particularly targeted. Pakistan also took advantage of the existence of liberal trade policies among European Community members, which allowed Pakistan to hide the final destination of a given equipment. But the most important reason was that despite the wake-up call of the Indian test, many European countries in the 1970s were not entirely committed to the best nonproliferation efforts. Proliferation was not yet much of a concern, and exports controls were particularly weak. There was also a political element. There was resistance to U.S. pressures, either because of some countries' independent political stance vis-à-vis the United States, such as France or Switzerland, or because of their desire to promote national products: as an observer puts it, "West Germany and the Netherlands made a national priority of promoting manufactured exports, particularly when they involved precision engineering, and they viewed some of the American lobbying about exports to Pakistan as just another form of trade competition."^[7] Also, Germany, the Netherlands, and the United Kingdom, the three URENCO countries, were overtly promoting an open enrichment market. Along with other European countries, they worried about a U.S. domination of the nuclear market: the formation of URENCO was "an act of resistance."^[8] Finally, the bureaucracies would not always implement political guidance. Attitudes would change only slowly.

In sum, three words can help understanding the attitudes of European firms and individuals involved in Pakistani nuclear imports: denial, delusion, and defiance.

Finally, there was the extent of A.Q. Khan's personal contacts on the continent. A.Q. Khan's personal contribution was to bring back a long list of companies and of individuals he personally knew, who could be helpful for Pakistani imports. After returning to Pakistan in December 1975, he wrote to several former colleagues to get specific technical information.^[9] He relied on long-time acquaintances such as Henk Slebos, a Dutch metallurgist he met in 1964; Peter Griffin, a British engineer he met in 1976; Friedrich Tinner, a Swiss engineer and long-time associate; Gotthard Lerch, a German engineer met in the 1970s; and Abdus Salam, a British national and another personal friend.

The high number of German companies involved in Pakistani nuclear imports can be explained by several factors. The know-how of this country in machine-tools, engineering and precision mechanics is well-known. Germany was also involved in the nuclear enrichment business through URENCO. Not being a nuclear power, its exports controls in this field were even less efficient than those of France and the United Kingdom for reasons of expertise. For the same reason, scientists and engineers with nuclear expertise from these two countries were likely to be involved in national nuclear programs. German nuclear exports controls were for a long time notoriously weaker than those of major other European States; this reflected a deliberate policy of self-assertiveness in the face of U.S. pressures.^[10] Finally, A.Q. Khan had extensive contacts in Germany dating from his stay in Europe. As a result, in 1990, a member of the German Parliament could say that the country's export controllers motto was still "you never hear anything, you never see anything—and, in particular, you never block anything."^[11] In 1989, the Stern magazine reported that throughout the 1980s, no less than 70 German firms had sold nuclear-related goods to enterprises known to be associated with the Pakistani program.^[12]

Some of these explanations also apply to Switzerland. Early Swiss nuclear exports restrictions were strictly respected even if it meant that a proliferation risk might be taken. As a commentator puts it, "rules are rules, especially to the Swiss."^[13] As in the case of Germany, the legalist stance of Berne was "part of a strategy to promote the interests of the Swiss industry."^[14] More specifically, in the case of Switzerland, some have perceived for a long time "a divergence between the Swiss ideal of neutrality that include freedom of trade and the concept of nonproliferation."^[15] These attitudes may have persisted. As late as 2004, the Malaysian police

report about the network was seen in some federal circles as “a possible attempt to damage the image of Switzerland abroad and the competitiveness of Swiss exports.”[16]

But U.S. exports were far from being immune to criticism. As late as 1994, a U.S. General Accounting Office report stated that they were still woefully inadequate.[17] Between 1998 and 1992, more than 80% applications for exports of nuclear-related equipment to Pakistan were approved (650 out of 808), including three to sensitive end-users (out of nine applications).[18] Pakistan actively sought materials and equipment from the United States. There is, in fact, a high number of documented “failures” by Pakistan to import nuclear-related material from the United States. This indicates either that the United States was particularly targeted, or that U.S. exports controls were more efficient—or a little bit of both, as is probable.

II. Reversing the Flow? Pakistani Nuclear Exports

Starting somewhere around the mid 1980s, Pakistan began to export its nuclear technology and know-how. However, the known cases of Pakistani exports are fairly different one from another. An in-depth examination of the four documented country cases (Iran, North Korea, Iraq, Libya) is necessary to understand the complexity of the Khan affair.

The Iranian case

Exports to Iran are a complex story. In fact, there seem to have been three different phases in the decade-long history of Pakistani transfers to Iran.

First, there was a period of limited cooperation probably approved by general Zia-ul-Haq himself, which began in 1987. A secret bilateral agreement was reportedly signed in 1987, which included provisions for training of Iranian scientists.[19] A negotiation took place in Dubai of the selling of P1 centrifuge diagrams, an enrichment plant diagram, and spare parts for at least one P1 machine.[20] Zia had, it seems, had authorized the initiation of a bilateral nuclear cooperation while asking for it to remain limited.[21] He did not want Iran to get the Bomb. Meanwhile, Khan was reportedly telling military authorities that the transfers were of very limited importance, since they concerned only used and or obsolete equipments.[22] He probably felt “covered” by Zia’s approval for technology transfers to Tehran. But he may also have been encouraged by general Mirza Aslam Beg, in his capacity of Army Vice-Chief of Army staff, who was ready to do more. MA Beg reports that emissaries from Iran first approached Pakistan near the end of the Iran–Iraq war, with broad requests of military sales, which were according to him denied by President Zia. This is consistent with what a former Pakistani ambassador to Iran reported, namely that Zia refused to abide by an Iranian request for mastery of the fuel cycle, made in Tehran in January 1988.[23]

After Zia’s death, the two parties may have envisioned a more complete cooperation, under pressure from general Beg, but probably with the knowledge of political authorities. A.Q. Khan was certainly encouraged to act in this direction by Beg and President Ghulam Ishaq Khan when they abruptly came to power after Zia’s death in August 1988. According to a Pakistani account, A.Q. Khan’s first move when Benazir Bhutto came to power (December 1988) was to ask her to make him PAEC director; when she refused, he chose to place his loyalty with MA Beg and GI Khan.[24] Beg has consistently denied having approved such transfers, but has confirmed the scope of nuclear discussions between Tehran and Islamabad at the time, at Iran’s initiative. But he and Benazir Bhutto were constantly telling them to go and see the other party.[25] A former U.S. administration official, Henry Rowen, says that Beg threatened in January 1990 to transfer military usage nuclear technology should Washington stopped arms sales to Pakistan.[26] There is evidence that Benazir Bhutto’s government knew about this cooperation. She was told in 1989 by Hashemi Rafsandjani that the Pakistani military had offered nuclear technology to Iran.[27]

A.Q. Khan has said that the transfers were encouraged by the military adviser to Mrs. Bhutto, general Imtiaz Ali, and explicitly authorized by Beg.[28]

In a third phase, the two countries seem to have begun a closer cooperation, in line with a growing convergence of interests. Two events changed the Pakistani perspective. One was the invasion of Kuwait. The other was the imposition of U.S. sanctions under the Pressler amendment. An Iranian-Pakistani nuclear cooperation was coherent with general Beg's strategic choices. Beg initially approved Pakistan's participation in the coalition against Iraq; but by the end of 1990 he changed his mind.[29] He actively sought a partnership with Iran to protect against the United States.[30] Political reasons were not the only ones at play: general Beg thought it was a good way to finance the defense budget, especially in the light of coming U.S. sanctions. There were high-level contacts to that effect between the two governments during the year 1991. Envoys of Hashemi Rafsanjani visited Sharif in February and July 1991. It is difficult to know with certainty what became of these projects. Some claim that Pakistan and Iran did agree on nuclear cooperation and discussed the possibility of mutual defense treaty.[31] What is clear is that the bilateral cooperation that was envisioned by the two countries was a two-way street: it did not concern only nuclear technology, but also conventional arms, probably oil, as well as mutual political support. The nuclear transfers of that period involved diagrams for P1 and P2 centrifuges, 500 used P1 centrifuges in a disassembled form—all delivered in the years 1994-1995; as well as a document describing "the casting of enriched and depleted uranium metal into hemispheres, related to the fabrication of nuclear weapons components." [32] Some shipments reportedly took place after 1995, perhaps as late as 2000.[33] This second influx of Pakistani technology to Iran took place during Mrs. Bhutto's second mandate. Given the extent of government-to-government contacts, it certainly took place with the knowledge of several key authorities.

The North Korean case

The Pakistan-North Korea strategic connection was established in 1971, when ZA Bhutto made Pyongyang a major source of conventional arms procurement. The Iraq-Iran war cemented the partnership between the two countries, who both aided Tehran's missile program.[34] A defense cooperation package was agreed upon at the occasion of Benazir Bhutto's December 1993 visit to Pyongyang. The precise role of A.Q. Khan remains unclear. He travelled several times to North Korea, and he may very well have been the initiator of the missile deal. He was given a tour of Pyongyang's nuclear facilities in 1999.[35] It is possible that he felt that he was "covered" by the military authorities because of the Iran precedent. In any case, it seems likely that the military knew about the nuclear exports. General Jehangir Karamat (chief of Army staff from 1996 to 1998) seems to have played a significant role in the DPRK-Pakistan connection.[36]

Known transfers lasted until around July 2002. According to Musharraf, "probably a dozen" centrifuges were sold.[37] Most available sources refer to P-1 technology, but some have suggested they may have included P-2 centrifuges.[38] There are also allegations of a broader cooperation in the nuclear area.[39]

The most likely explanation of what happened with North Korea is that it was a *quid pro quo*. This is what the U.S. government believed in the late 1990s.[40] However, the story may be more complex. Nuclear exports began much later than missile imports. Bhutto is on the record for stating that her 1993 deal involved paying for the missiles in cash. Well-informed analysts have stated that the latter were financed by "money and rice." [41] The Pakistani "reserve crunch" might have prompted Pakistan to turn from cash to nuclear technology in return for missile technology.[42] The most detailed studies about the DPRK-Pakistan relationship have refrained from drawing definitive conclusions about its nature, especially given the uncertainties about the exact scope of the nuclear relationship.[43]

The Iraqi case

Available sources indicate that the initial contact with Iraq was made just a few weeks after the invasion of Kuwait. A note from the Iraqi intelligence services, dated October 6, reports that A.Q. Khan was ready to help Baghdad to “establish a project to enrich uranium and manufacture a nuclear weapon.” It reported that A.Q. Khan was prepared to give Iraq “project designs for a nuclear bomb.” Equipments were to be transferred from European companies to Iraq via a Dubai-based company.[44] The Iraqi government, however, feared that it was a sting operation.[45]

Such a gesture would have been consistent with general Beg’s opposition to Pakistani participation in the international coalition. At the same time, however, if Beg was keen to help Iran, it would have been illogical for him to support the development of an Iraqi bomb at the same time. Helping Saddam Hussein, Iran’s mortal enemy, to get nuclear weapons might have been consistent with Beg’s political preferences (a staunch opponent of U.S. influence in the region), but completely at odds with his personal culture (a Shi’a with strong admiration for Iran).

The Libyan case

While the nuclear relationship with Libya began in the mid-1970s, concrete transfers took place only after the reinvigoration of Libya’s program in 1995. Contact was made through the Khan network at that time.[46] In 1997, Libya received 20 complete L1 centrifuges and most of the components for another 200. In 2000, it received two complete but “second-hand” L2 centrifuges, as well as one cylinder containing 1.7 ton of UF₆. In late 2001 or early 2002, documentation on nuclear weapon design, including the “Chinese blueprint,” was transferred. In late 2002, components for a large number of L2 began to arrive.[47]

The reasons behind the Libya transfers remain unclear. Personal greed, and perhaps a temptation to give the Bomb to a Muslim country that had helped so much Pakistan in the past were in all likelihood the determining factors. But one has to wonder how it was possible that transfers of nuclear technology to Libya could have taken place after 2001. It seems that A.Q. Khan was allowed to continue his travels even after he was ousted of KRL in March 2001.[48] The reason may be that he had the keys to the imports network, still vital for the Pakistani nuclear program. (He remained “Special Adviser to the Chief Executive on Strategic and KRL Affairs” after his dismissal.)

III. Understanding the Nature of the Network

Different cases, different responsibilities

Pakistani nuclear exports were probably, to a significant extent, an individual initiative. Most knowledgeable observers of the Pakistani scene agree that A.Q. Khan had an important degree of autonomy. If nuclear exports had been a consistent State policy, then it would have been logical that PAEC had a role in it too, which does not seem to have been the case. This does not exonerate Pakistani authorities but, as an observer put it, “Khan likely exceeded whatever mandate he received from the Pakistani leadership.”[49] He may have felt that he was “covered” for whatever he did by the large amount of trust and autonomy he was enticed with. It seems in fact that A.Q. Khan was able to manipulate the government and the Pakistani authorities did not want to know what was going on. For instance, he would tell the Prime minister that he needed to Iran for reasons of national security, and that would be enough. “As long as Khan’s group delivered the goods, no state authority questioned his tactics.”[50] Khan’s personal profits were reportedly known by the ISI since 1988, but Pakistan’s military authorities refused to act.[51] Such moves were made easy by the secrecy and compartmentalization of Pakistan’s program until the late 1990s, which did not create the best conditions for oversight.

Three events changed the picture: the 1998 tests, the 1999 coup, the 2001 attacks and their aftermath. There was a progressive reorganization of Pakistan's nuclear program between 1998 and 2001. The nuclear laboratories were reined in and A.Q. Khan was forced to retire. Several explanations exist as per the reasons of this decision. Some U.S. officials have said that this was an American request.^[52] It may also have been Musharraf's own initiative—or a combination of both. After the 1998 tests, Pakistan was under strong pressure from the United States to show responsible behaviour, and in dire need of Western assistance. An inquiry by the newly-created National Accountancy Bureau had revealed unapproved financial transactions; it was not pursued due to the sensitivity of the matter.^[53] According to several sources, the ISI followed A.Q. Khan to Dubai in the fall of 2000. When asked for an explanation by Musharraf, who was concerned about financial improprieties, he complained about the surveillance, gave false excuses and continued his travels.^[54] The same thing happened when he was asked by Musharraf to explain an aircraft landing in Iran.^[55] A.Q. Khan was clearly reluctant to abide by the new rules, which included a better oversight of nuclear officials. He was making it known that he disapproved the reorganization of Pakistani nuclear policy.^[56]

To understand the complexity of the case, and the reasons why it remains difficult, to this day, to distinguish the various responsibilities, it is important to note that most known exports happened between 1988 (the death of Zia) and 1999 (the Musharraf takeover). In August 1988, the program came into the hands of President chairman G.I. Khan and chief of Army staff Mirza Aslam Beg. In the ensuing decade, the structure of Pakistani power was complex, and divided amongst three individuals: the President, the Prime Minister, and the chief of Army staff. For this reason, it is obviously difficult to answer to the question “who knew what?”

What seems clear is twofold. First, the Prime Ministers during that period (Bhutto and Sharif in particular) were not completely out of the loop. Indeed, the Pakistani government openly acknowledges the role of two individuals close to the Bhutto family: general Ihtiaz Ali, military secretary to ZA Bhutto and defense adviser to his daughter Benazir, and family dentist (*sic*) Zafar Niazi.^[57] Second, a handful of Pakistani leaders seem to have played a key role. One was general MA Beg. There is ample evidence of his involvement in Iranian-Pakistani nuclear cooperation. As stated above, his personal background and political preferences led him to take a consistent pro-Iranian, anti-American stance. Another key individual may have been president G.I. Khan. One source reported Khan as being actually in charge of the nuclear program from 1975 until 1991.^[58] As defense minister, he was involved in the decision to make Kahuta a separate entity under A.Q. Khan.^[59] He was a member of the three-men KRL coordination board when it was created in 1976.^[60] As finance minister, he was present at the first 1983 cold tests.^[61] He also gave tax-free status to the BCCI, which was used as a conduit for Pakistani nuclear imports and exports.^[62] Finally, it is hardly conceivable that successors to MA Beg as chiefs of Army staff (generals Nawaz, Kakar, Karamat, and Musharraf) were unaware of any transfers of nuclear technology. At the very least, they proved unwilling to ensure that A.Q. Khan was not able to proceed with unsanctioned exports. A.Q. Khan has reportedly admitted that both Kakar and Karamat knew and approved of his dealings with North Korea.^[63] Finally, during the period 1987-1999, A.Q. Khan, who was certainly good at manipulating the system, may have been himself manipulated as to ensure “plausible deniability.”

Pakistani nuclear exports were thus partly a personal initiative, partly a State policy, in various proportions according to the circumstances. Different transfers probably reflected different situations. The apparent *quid pro quo* with North Korea may have been a State policy made with knowledge of most high-level Pakistani authorities, including Bhutto and Sharif. Of course, no element of Islamic solidarity was present there. Rather, it was the need to ensure the continued development and reliability of the liquid-fuel Pakistani missiles. The case of Libya was probably an A.Q. Khan initiative. However, this may also have been “payback time”: when Tripoli agreed to give financial support for the Pakistani program in the early 1970s, it asked for nuclear technology in return. ZA Bhutto never committed himself to go that far.^[64] But he may have created expectations in Ghaddafi's mind. The offer to Iraq was probably A.Q. Khan's own initiative. Iran is

the most complex case. The launching of a military-oriented nuclear cooperation was probably not sanctioned by President Zia ul-Haq. However, in the period 1988-1995, exports to Iran were known by most Pakistani leaders, including Prime Ministers Bhutto and Sharif, and deliberately encouraged by some, such as MA Beg and GI Khan.

It seems that there was no constant and consistent State policy governing the nuclear exports made, or sanctioned, by Pakistani officials in the past 30 years. Concrete interests, personal and national, seem to have been the primary driver behind these exports. They were made possible by the large freedom of manoeuvre given to A.Q. Khan's activities until the end of the 1990s. But there was, at least in one instance, in the late 1980s, an attempt to make nuclear exports part of a broader national strategic orientation.

Not a Wal-Mart, but an imports-exports enterprise

Pakistani nuclear-related exports began about a decade after their imports network was set up in the mid-1970s. The Pakistanis thus had acquired a very significant experience in dealing with nuclear transfers, legal and illegal. Contacts and procedures used for Pakistani imports were sometimes of direct use to exports when they involved transfers from Western firms, intermediaries and shell companies.

Once fully matured, it comprised several main nodes: the UAE (the company's headquarters), Malaysia, Turkey, South Africa—not including various personal properties around the world. There were half a dozen workshops around the globe, with Dubai serving as the main platform for re-exporting. A.Q. Khan set up dozens of shell companies to that effect, sometimes just for one-time use. A total of about 50 people were actively involved in the network.^[65] But A.Q. Khan operated with a dozen of key close associates. It was in more than one respect a family business. Buhary Syed Abu Tahir, a Sri Lankan national, was the chief operating officer of the exports network. His headquarters were the Dubai-based firm SMB Computers. His uncle, S.M. Farouq, was another key operative. Peter Griffin designed the Libyan Machine Shop 1001, and imported machines from Spain and other European countries for that project.^[66] Mohammed Farooq was a KRL official in charge of procurement and sales abroad.^[67] Paul Griffin (son of Peter Griffin), operated Gulf Technical Industries, one of the main Dubai-based front companies. Urs Tinner, a Swiss national and long-time associate of A.Q. Khan, as well as his father Friedrich and his brother Marco, were involved in both the Iran and Libya enterprises. Heinz Mebus, an old college classmate, was involved in sales to Iran. Gotthard Lerch, another long-time associate, has been described as the “division manager for the Libya business” and Tahir's “main contractor.” He was in particular in charge of the South African node.^[68] He involved Gerhard Wisser (a German mechanical engineer) in the Libya operation, who in turn involved Daniel Geiges (a Swiss mechanical engineer) and Johan Meyer (a South African engineer).^[69]

The main companies reportedly involved in centrifuges exports were: Khan Research Laboratories (Pakistan): ring magnets, aluminium and maraging steel, flow-forming and balancing equipment, vacuum pumps, non-corrosive pipes and valves, end-caps and baffles, power supply; Scomi Precision Engineering (Malaysia): aluminium and maraging steel, end-caps and baffles; SMB Computers (UAE): non-corrosive pipes and valves, end-caps and baffles, power supply; ETI Elektrotechnik (Turkey): aluminium and maraging steel, power supply; and Trade Fin (South Africa): flow-forming and balancing equipment, vacuum pumps, non-corrosive pipes and valves.^[70] Other companies involved included Bikar Mettale Asia (Singapore), Hanbando Balance Inc. (South Korea), Krisch Engineering (South Africa), CETEC (Switzerland), Traco (Switzerland), and EKA (Turkey).^[71] Equipments for Libya were imported by the Tinner family from Spain (vacuum pumps, flow-forming machines), Italy (special furnaces), France, the United Kingdom and Taiwan (machine-tools), as well as Japan (a 3-D measuring tool).^[72]

The story cannot be reduced to a mere “reversal of the flow.” Most of the imports network remained insulated from the exports. And the North Korean deal does not seem to have

implicated the network: it was a State-to-State enterprise, which may have included a personal initiative by A.Q. Khan with support from military authorities. By contrast, Libya, which was by far the biggest known A.Q. Khan operation, was an *ad hoc* project which fully involved Khan's associates, and was probably hidden from the political authorities.

But there were clear links between the imports and exports networks. Some of the components that A.Q. Khan exported were also components he needed for the national program; thus, starting in the mid-1980s, he reportedly began to order more components than necessary for the national program.^[73] Some of the network's customers, such as Iran, received "second-hand" centrifuges—those which were replaced by newer models for Pakistan's national programs. Several key individuals involved in Pakistani exports were also involved in the imports. Mohammed Farooq, A.Q. Khan's principal deputy, was reportedly in charge of overseas procurement for KRL.^[74] Others were long-time associates, who he had met in the 1960s and 1970s. They included Peter Griffin (who was involved in early imports of inverters from the UK); Gotthard Lerch (who used to work at Leybold Heraeus, which was to become a key contractor of Pakistan); Otto Heilingbrunner (same); Henk Slebos (who studied with A.Q. Khan, used to work at Explosive Metal Works Holland and sold various equipment to Pakistan over the years); Friedrich Tinner (who used to work at Vacuum Apparate Technik, a firm who sold equipment to Pakistan in the 1970s); and Heinz Mebus (who was involved in the first centrifuge transfers to Iran in the mid-1980s). Other elements of commonality exist between the two networks. Tactics designed to fool Western exports controls were learned for imports and used for exports. States such as the UAE and Turkey were major platforms for both imports and exports. And the BCCI was, it seems, one of the conduits used (until its demise in 1991) for payments made to Pakistani officials.^[75]

Thus the network was not a "Wal-Mart," as IAEA Director General Mohammed El-Baradei wrongly characterized it. Rather, it was an "Imports-Exports Enterprise." From the initial import-oriented network under the direction of MA Khan, a separate, export-oriented branch developed under the direction of A.Q. Khan, starting in the mid-1980s. In the late 1990s, it became more decentralized as A.Q. Khan realized he was under surveillance. It became a "privatized subsidiary" of the imports network.

Also, the network did not export the whole range of Pakistani technology. It sold or gave know-how on uranium enrichment and weapons design, and centrifugation technology. Again, the "Wal-Mart" comparison goes too far.

IV. Learning from the Pakistani Experience

Two additional conclusions can be drawn from this brief survey for the future study and understanding of proliferation networks.

The first one is that we should not be surprised that the uncovering of A.Q. Khan's activities did not kill the network. This is only logical since the exports was only one part of the Pakistani machinery, loosely affiliated with the rest of the network. Recent developments show that Pakistan has indeed continued to seek nuclear imports after 2003.^[76] In August 2005, Asher Karni, an Israeli businessman, arrested in January 2004, was condemned in the United States to have exported or attempted to export, via South Africa and the UAE, 200 triggered spark gaps as well as high-tech oscilloscopes to Pakistan.^[77] In November, Rainer Vollmerich, a German businessman, was condemned for having exported to Pakistan, until 2004, mechanical and electronic equipment with military nuclear use.^[78] In May 2005, Swiss federal police stated it had precluded two attempts at exporting aluminium tubes of Russian origin to KRL.^[79] In July, an European confidential report stated that Pakistan was still "shopping" for high-grade aluminium, ring magnets, and machine-tools that could be useful for its nuclear program. The document reportedly listed 20 Pakistani institutions involved in such imports.^[80] Finally, in 2006, the

Russian government revealed that Pakistan had been actively searching for nuclear-related technology in the country.[81] Some Pakistani officials have argued that Pakistani needs to continue buying abroad because of damage done to key installations by the October 2005 earthquake.[82] While this rationale may be overstated, it seems that Pakistan will continue to import foreign components as spare parts and upgrades for the modernization of its facilities and weapons. The construction of a second heavy-water reactor at Khushab, which is currently underway, may also imply additional imports.

The second conclusion, and perhaps the most important one, is that the A.Q. Khan network is probably unique. Its efficiency can be explained by the fact that it was based on a State network. Creating a nuclear exports enterprise is easier than it was 20 or 30 years ago. For instance, as an observer puts it, "computers now can do the work that in the past only very sophisticated engineers could do. In the past, making the parts required extraordinary skill in hand-machining. Now poorer countries with weaker industrial bases can essentially download the software, plug it into a machine, and cut rare metal alloys as well as a Swiss craftsman could thirty years ago." [83] But it is hardly conceivable that another Khan-like network could exist without being the offspring of a State machinery. In other words, the "next A.Q. Khan," if there is one, will not be an isolated individual but somebody with access and experience drawn from a country's national nuclear program. In sum, the "next A.Q. Khan" could only be, for instance, Iranian or North Korean.

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