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Botching the Bomb

Why Nuclear Weapons Programs Often Fail on Their Own—and Why Iran’s Might, Too

Jacques E. C. Hymans

THE CHRONIC problem of nuclear proliferation is once again dominating the news. A fierce debate has developed over how to respond to the threat posed by Iran’s nuclear activities, which most experts believe are aimed at producing a nuclear weapon or at least the capacity to assemble one. In this debate, one side is pushing for a near-term military attack to damage or destroy Iran’s nuclear program, and the other side is hoping that strict sanctions against the Islamic Republic will soften it up for a diplomatic solution. Both sides, however, share the underlying assumption that unless outside powers intervene in a dramatic fashion, it is inevitable that Iran will achieve its supposed nuclear goals very soon.

Yet there is another possibility. The Iranians had to work for 25 years just to start accumulating uranium enriched to 20 percent, which is not even weapons grade. The slow pace of Iranian nuclear progress to date strongly suggests that Iran could still need a very long time to actually build a bomb—or could even ultimately fail to do so. Indeed, global trends in proliferation suggest that either of those outcomes might be more likely than Iranian success in the near future. Despite regular warnings that proliferation is spinning out of control, the fact is that since the 1970s, there has been a persistent slowdown in the pace of technical progress on nuclear weapons projects and an equally dramatic decline in their ultimate success rate.

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The great proliferation slowdown can be attributed in part to U.S. and international nonproliferation efforts. But it is mostly the result of the dysfunctional management tendencies of the states that have sought the bomb in recent decades. Weak institutions in those states have permitted political leaders to unintentionally undermine the performance of their nuclear scientists, engineers, and technicians. The harder politicians have pushed to achieve their nuclear ambitions, the less productive their nuclear programs have become. Meanwhile, military attacks by foreign powers have tended to unite politicians and scientists in a common cause to build the bomb. Therefore, taking radical steps to rein in Iran would be not only risky but also potentially counterproductive, and much less likely to succeed than the simplest policy of all: getting out of the way and allowing the Iranian nuclear program's worst enemies—Iran's political leaders—to hinder the country's nuclear progress all by themselves.

NUCLEAR DOGS THAT HAVE NOT BARKED

"TODAY, ALMOST any industrialized country can produce a nuclear weapon in four to five years," a former chief of Israeli military intelligence recently wrote in *The New York Times*, echoing a widely held belief. Indeed, the more nuclear technology and know-how have diffused around the world, the more the timeline for building a bomb should have shrunk. But in fact, rather than speeding up over the past four decades, proliferation has gone into slow motion.

Seven countries launched dedicated nuclear weapons projects before 1970, and all seven succeeded in relatively short order. By contrast, of the ten countries that have launched dedicated nuclear weapons projects since 1970, only three have achieved a bomb. And only one of the six states that failed—Iraq—had made much progress toward its ultimate goal by the time it gave up trying. (The jury is still out on Iran's program.) What is more, even the successful projects of recent decades have needed a long time to achieve their ends. The average timeline to the bomb for successful projects launched before 1970 was about seven years; the average timeline to the bomb for successful projects launched after 1970 has been about 17 years.

International security experts have been unable to convincingly explain this remarkable trend. The first and most credible conventional explanation is that the Nuclear Nonproliferation Treaty (NPT) has prevented a cascade of new nuclear weapons states by creating a system of export controls, technology safeguards, and on-site

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inspections of nuclear facilities. The NPT regime has certainly closed off the most straightforward pathways to the bomb. However, the NPT became a formidable obstacle to would-be nuclear states only in the 1990s, when its export-control lists were expanded and Western states finally became serious about enforcing them and when international inspectors started acting less like tourists and more like detectives.

Yet the proliferation slowdown started at least 20 years before the system was solidified. So the NPT, useful though it may be, cannot alone account for this phenomenon.

A second conventional explanation is that although the NPT regime may not have been very effective, American and Israeli bombs have been. Syria's nascent nuclear effort, for instance, was apparently dealt a major setback by an Israeli air raid on its secret reactor construction site in 2007. But the record of military strikes is mixed. Contrary to the popular myth of the success of Israel's 1981 bombing of the Osiraq reactor in Iraq, the strike actually spurred Iraqi President Saddam Hussein to move beyond vague intentions and commit strongly to a dedicated nuclear weapons project, which lasted until the 1990-91 Gulf War. Moreover, the bombs that the United States dropped on Iraq during that conflict mostly missed Saddam's nuclear sites.

Finally, some analysts have asserted that nuclear weapons projects become inefficient due to political leaders' flagging levels of commitment. But these analysts are reversing cause and effect: leaders lose interest when their nuclear programs are not running well. And some nuclear weapons projects, such as France's, have performed well despite very tepid support from above. The imperfect correlation between the commitment of leaders and the quality of nuclear programs should not be surprising, for although commentators may speak

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casually of “Mao’s bomb” or “Kim Jong Il’s bomb,” the real work has to be carried out by other people.

ARRESTED DEVELOPMENT

A MORE CONVINCING explanation of the proliferation slowdown begins with the observation that during the early days of the nuclear age, most states with nuclear ambitions were in the developed world, whereas since the mid-1960s, most would-be nuclear states have been in the developing world. As proliferation has become a mainly developing-world phenomenon, timelines to the bomb have slowed down dramatically. But the relevant difference here is not primarily economic. Some nuclear programs in very poor states have fared rather well, such as the one undertaken by famine-stricken China in the 1950s and 1960s. Conversely, wealthy oil states, such as Iraq and Libya, spent vast amounts on decades-long nuclear quests but still failed.

National income is only one dimension of development, however, and in this case it is not the most important one. As the political scientist Francis Fukuyama has stressed, despite strong rates of economic growth, most developing countries struggle to establish high-quality state bureaucracies. And a dysfunctional bureaucracy is likely to produce a dysfunctional nuclear weapons project.

Nuclear research and development organizations depend heavily on intense commitment, creative thinking, and a shared spirit of cooperation among large numbers of highly educated scientific and technical workers. To elicit this positive behavior, management needs to respect their professional autonomy and facilitate their efforts, and not simply order them around. Respect for professional autonomy was instrumental to the brilliant successes of the earliest nuclear weapons projects. Even in Stalin’s Soviet Union, as the historian David Holloway has written, “it is striking how the apparatus of the police state fused with the physics community to build the bomb. . . . [The physics community’s] autonomy was not destroyed by the creation of the nuclear project. It continued to exist within the administrative system that was set up to manage the project.”

By contrast, most rulers of recent would-be nuclear states have tended to rely on a coercive, authoritarian management approach to advance their quest for the bomb, using appeals to scientists’ greed

and fear as the primary motivators. That coercive approach is a major mistake, because it produces a sense of alienation in the workers by removing their sense of professionalism. As a result, nuclear programs lose their way. Moreover, underneath these bad management choices lie bad management cultures. In developing states with inadequate civil service protections, every decision tends to become politicized, and state bureaucrats quickly learn to keep their heads down. Not even the highly technical matters faced by nuclear scientific and technical workers are safe from meddling politicians. The result is precisely the reverse of what the politicians intend: not heightened efficiency but rather a mixture of bureaucratic sloth, corruption, and endless blame shifting.

Although it is difficult to measure the quality of state institutions precisely, the historical record strongly indicates that the more a state has conformed to the professional management culture generally found in developed states, the less time it has needed to get its first bomb and the lower its chances of failure. Conversely, the more a state has conformed to the authoritarian management culture typically found in developing states, the more time it has needed to get its first bomb and the higher its chances of failure.

Of course, not all developing states share the same model. For instance, as the political scientist Samuel Huntington famously argued, the Soviet Union's "bureaucratic" form of communism was merely a variation on the basic archetype of the western European state. Thus, although the Soviet Union was bad at many things, it was good at "big science." Likewise, China's successful nuclear weapons project took place at a time when the Chinese Communist Party was still clinging to the Soviet bureaucratic communist model, despite Chairman Mao Zedong's best efforts to wreck it. The Chinese nuclear program fared poorly when Mao was manhandling the party, but it fared well when the party was able to keep him at bay, which it managed to do just long enough to attain the bomb.

THE IRAQI NUCLEAR MIRAGE

THE CASE of Iraq's nuclear activities in the 1980s might seem to contradict the idea that the global proliferation slowdown has resulted from poor management practices. After all, according to the conventional wisdom in Washington, Iraq had come to within just a few months of

obtaining its first bomb when the Gulf War serendipitously intervened. But in fact, the Iraqi case provides a clear instance of authoritarian mismanagement leading to an inefficient nuclear weapons project.

In the years leading up to Israel's 1981 attack on Iraq's half-built Osiraq reactor, Iraq's nuclear program had been ravaged by one of Saddam's periodic fits of peremptory dismissals and jailings of officials and scientists. But immediately after the strike, Saddam released Iraq's top nuclear scientist, Jafar Dhia Jafar, from house arrest and reinstated him as the head of the nuclear program. (Jafar had been detained after objecting to the jailing of another top nuclear scientist.) Jafar's return marked the beginning of Iraq's dedicated nuclear weapons project. For a while, the project progressed well. The Israeli attack had awakened the nationalist pride of Iraq's nuclear scientists, and they were determined to succeed.

But in the mid-1980s, the program fell victim to a power grab by Hussein Kamel al-Majid, Saddam's powerful son-in-law. Kamel's reign over the nuclear program was almost a caricature of a coercive management approach. He imposed unrealistic deadlines for technical progress, causing machines and human beings alike to crack under the pressure. He pitted scientists against one another in brutal competition, forcing them to duplicate work that others had already completed. When progress toward the bomb appeared to stall, he demanded dramatic technical changes, rendering prior work practically meaningless. And his pursuit of sensitive materials on the international black market was so blatant that by the end of the 1980s, even the sleepest non-proliferation watchdogs had begun to take notice.

Kamel relentlessly bullied his scientists, with predictable results. For instance, in 1987, he asked Mahdi Obeidi, the leader of the team tasked with building gas centrifuges, how long it would take to get the first one up and running. Obeidi imagined two years but, fearful of displeasing Kamel, said one year. In response, Kamel told Obeidi that he had 45 days. The result was a mad dash that caused the finely crafted, costly centrifuge rotor to crack on its first test run. Thanks to this rampant mismanagement, Iraq still had not produced any weapons-grade highly enriched uranium at all by the time the Gulf War intervened, even after spending \$1 billion on ten years of work and despite successfully concealing the bulk of its program from the outside world. The Iraqi program was a "spectacular failure," according to Robert Kelley, a

former inspector for the International Atomic Energy Agency (IAEA). “This was probably one of the most expensive undertakings in the history of mankind in terms of dollars spent to material produced.”

After the Gulf War, international inspectors were shocked to find many large, well-equipped secret nuclear facilities in Iraq. With all that fancy equipment, Iraq probably could have built the bomb within a couple of years—if it had been able to count on a well-motivated, professional scientific and technical team. But by 1991, after years of coercive, authoritarian mismanagement, Iraq’s scientific and technical workers had become exhausted, cynical, and divided. Most security analysts have been slow to understand this reality and have perpetuated the myth that Iraq was very close to building a bomb before the Gulf War.

Outside analysts have also overstated the threat posed by Iraq’s “crash program,” which was launched immediately after Saddam’s 1990 invasion of Kuwait. The crash program was a last-ditch attempt to make a bomb with highly enriched uranium reactor fuel that Iraq had legally purchased under international safeguards in the late 1970s. In retrospect, those transfers should not have been permitted. But Iraq’s management problems affected the crash program just as much as they affected every other aspect of the nuclear weapons project. As a result, even the crash program was badly stalled before the end of the Gulf War. Hence, from a strategic point of view, it did not matter that U.S. bombs missed Iraq’s nuclear sites in 1991, because the Iraqi nuclear program had already crumbled from within.

CAVEAT EMPTOR

IRAQ’S EXPERIENCE notwithstanding, many proliferation analysts insist that although technologically backward states might not have been capable of nuclear weapons development in the past, they can now simply purchase all they need in the freewheeling globalized marketplace. Admittedly, illicit nuclear entrepreneurs—such as A. Q. Khan, the rogue Pakistani scientist who sold nuclear technology to Iran, Libya, and North Korea—do pose a threat. But international nuclear technology transfers often fail because the dysfunctional states that are trying to get the bomb are hardly any better at exploiting foreign nuclear know-how than they are at developing their own.

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Libya's misbegotten nuclear weapons project reflects this general pattern. Despite buying all the items in Khan's catalog, Libya was unable to "put them together and make them work," according to a 2005 U.S. government report. Indeed, when IAEA inspectors gained access to Libyan nuclear facilities after Libya's president, Muammar al-Qaddafi, abandoned the project in 2003, they found much of the imported merchandise still in its original packing crates.

As for some analysts' terrifying predictions of ex-Soviet nuclear scientists and technicians leaving home en masse to further the nuclear ambitions of rogue regimes, this is more the stuff of Hollywood than a genuine problem. Ex-Soviet researchers vastly prefer the professional establishments of the West over the secret lairs of brutal dictators. Moreover, developing-state rulers need to be wary of recruiting outsiders, since the few genuine nuclear experts available can be hard to distinguish from the scores of frauds and spies also on the market. Take, for instance, the case of Argentine President Juan Perón's post-World War II recruitment of Nazi scientists. This was perhaps the most successful effort to produce a reverse scientific brain drain in history. Yet Ronald Richter, the Austrian physicist whom Perón chose to head his nascent nuclear program, turned out to be part con man and part madman. Perón realized his error only after the snickering worldwide reaction to his 1951 announcement that Richter had succeeded in producing controlled fusion.

TARDY IN TEHRAN

IN THE intensifying crisis over Iran's nuclear activity, the great proliferation slowdown has gone all but unmentioned. Yet this robust global trend clearly indicates a need to guard against any hasty conclusion that Iran's nuclear program is about to achieve its ultimate aims. Iran's nuclear scientists and engineers may well find a way to inoculate themselves against Israeli bombs and computer hackers. But they face a potentially far greater obstacle in the form of Iran's long-standing authoritarian management culture. In a study of Iranian human-resource practices, the management analysts Pari Namazie and Monir Tayeb concluded that the Iranian regime has historically shown a marked preference for political loyalty over professional qualifications. "The belief," they wrote, "is that a loyal person can learn new skills, but it is much more difficult

to teach loyalty to a skilled person.” This is the classic attitude of authoritarian managers. And according to the Iranian political scientist Hossein Bashiriye, in recent years, Iran’s “irregular and erratic economic policies and practices, political nepotism and general mismanagement” have greatly accelerated. It is hard to imagine that the politically charged Iranian nuclear program is sheltered from these tendencies.

It is surely more difficult to assess the quality of Iran’s nuclear management than it is to count the number of Iranian centrifuge machines. But such an assessment is vital, because the progress of Iran’s program will depend on how much professional autonomy its scientists and engineers are able to retain. In the meantime, a number of broad lessons from the great proliferation slowdown can help provide a more sober assessment of the situation.

The first lesson is to be wary of narrow, technocentric analyses of a state’s nuclear weapons potential. Recent alarming estimates of Iran’s timeline to the bomb have been based on the same assumptions that have led Israel and the United States to consistently overestimate Iran’s rate of nuclear progress for the last 20 years. The majority of official U.S. and Israeli estimates during the 1990s predicted that Iran would acquire nuclear weapons by 2000. After that date passed with no Iranian bomb in sight, the estimate was simply bumped back to 2005, then to 2010, and most recently to 2015. The point is not that the most recent estimates are necessarily wrong but rather that they lack credibility. In particular, policymakers should heavily discount any intelligence assessments that do not explicitly account for the impact of management quality on Iran’s proliferation timeline.

The second lesson of the proliferation slowdown is that policymakers should reject analyses based on assumptions about a state’s capacity to build nuclear programs in secret. Ever since the mid-1990s, official proliferation assessments have freely extrapolated from minimal data, a practice that led U.S. intelligence analysts to wrongly conclude that Iraq had reconstituted its weapons of mass destruction programs after the Gulf War. The United States must guard against the possibility of an equivalent intelligence failure over Iran. This is not to deny that Tehran may be keeping some of its nuclear work secret. But it is simply unreasonable to assume, for example, that Iran has compensated for the problems it has faced with centrifuges

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at the Natanz uranium-enrichment facility by hiding better-working centrifuges at some unknown facility. Indeed, when Iran has tried to hide weapons-related activities in the past, it has often been precisely because the work was at the very early stages or was going badly.

The third lesson is that states that poorly manage their nuclear programs can bungle even the supposedly easy steps of the process. For instance, based on estimates of the size of North Korea's plutonium stockpile and the presumed ease of weapons fabrication, U.S. intelligence agencies thought that by the 1990s, North Korea had built one or two nuclear weapons. But in 2006, North Korea's first nuclear test essentially fizzled, making it clear that the "hermit kingdom" did not have any working weapons at all. Even its second try, in 2009, did not work properly. Similarly, if Iran eventually does acquire a significant quantity of weapons-grade highly enriched uranium, this should not be equated with the possession of a nuclear weapon.

The fourth lesson is to avoid doing anything that might motivate scientific and technical workers to commit themselves more firmly to the nuclear weapons project. Nationalist fervor can partially compensate for poor organization. Therefore, violent actions, such as aerial bombardments or assassinations of scientists, are a loser's bet. As shown by the consequences of the Israeli attack on Osiraq, such strikes are liable to unite the state's scientific and technical workers behind their otherwise illegitimate political leadership. Acts of sabotage, such as the Stuxnet computer worm, which damaged Iranian nuclear equipment in 2010, stand at the extreme boundary between sanctions and violent attacks, and therefore they should be undertaken only after very thorough consideration.

Traditionally, nonproliferation strategy has revolved around persuading leaders to stop desiring nuclear weapons and depriving nuclear scientists of the tools necessary to build them. But scientists have motivations, too, and policymakers must keep in mind this critical third dimension of nuclear programs' efficiency. The world is lucky that during the past few decades, the leaders of would-be nuclear weapons states have been so good at frustrating and alienating their scientists. The United States and its partners must take care not to adopt policies that resolve those leaders' management problems for them. 🌐