Foreign Policy

Research Institute

E-Notes

A Catalyst for Ideas *Distributed Exclusively via Fax & Email* June 2008

TECHNOLOGICAL INNOVATION AND NATIONAL SECURITY

By Paul Bracken

Of the United States' $600 billion defense budget, at least 40-50 percent goes to technology. Technology issues are extremely important in national security, and I would like to give an overview of some of the major issues and a range of frameworks in which to view them. However, it has to be noted that there is no one best framework in which to look at these issues. Rather, there are several; I will discuss a few of them, each of which provides its own unique insights.

To ground the subject, there are many conventional views about technology and national security. One common view, particularly in political science and social science departments, is that technology doesn't make much difference at all--we should think more about strategy and be smart, rather than buy technology to gain capabilities we would not otherwise have. I heard a variation of this recently in a talk by a State Department official who pointed out that if you take the State Department budget, add foreign aid, and divide it by the Pentagon budget, it reaches 5 percent. That is, 5 percent of the total national security budget is given to diplomacy. The clear implication--which may be correct or not--is that money should be shifted from the military budget to diplomacy, foreign aid, etc.

A second view is that the U.S. is getting soft--the Chinese are producing far more engineers, while we produce MBAs and lawyers. Upon closer examination, this common view turns out to be not entirely accurate. The numbers of Chinese engineers are grossly overstated, because they include what we would call technicians from community colleges. The IT support person in the U.S. would be classified as an engineer in China. On the other hand, there are indeed numerous issues in U.S. universities, and in the broader American economy, that make it difficult for a student to want to major in engineering. Simply because critics have overstated Chinese education capacity to make their point does not mean that they do not have a point to make. From my dealing with very bright college students I see many obstacles for them to major in engineering.

Probably the most popular common way of looking at technological innovation and national security in the U.S. is, "Are we still ahead?" This year for the first time, China will spend more on R&D than Japan. China is really going into technology in a big way. So the question "Can we keep the lead?" is natural to ask.

These common views aren't necessarily wrong, but there are different frameworks that pose different questions. What we should do is collect all of the good insights from various frameworks to see where we are on the subject of technological innovation and national security. Let me give some examples.

In the 2006 Lebanon-Israel war, Hezbollah used short-range rockets to rain down death on the northern part of Israel. Israel evacuated 150,000 people out of northern Israel into tents in Israeli national parks to get them out of harm's way. In the process, Hezbollah also fired a cruise missile and almost scored a catastrophic kill on an Israeli warship. Fortunately, the bomb exploded outside the ship. The Winograd Commission formed to investigate this war concluded that Hezbollah, a semi-military organization, with a few thousand people, was able to resist the Israeli Defense Forces, the strongest army in the Middle East. Hezbollah used technology to match its tactics, knowing that if it took on Israel in a direct, head-to-head war with conventional forces, it would not stand a chance.

This is all very suggestive of what other countries are going to do when they look at the U.S. Fighting the U.S. with advanced conventional forces is suicide. Fighting in others ways is not.

ENDS AND MEANS

Another model of innovation and technology is a success story. Technology, innovation, and national security from 1977-81, were highly integrated and aligned. U.S. Secretary of Defense Harold Brown and Undersecretary William Perry decided to "offset" Soviet military advantages not with more manpower and bigger armies, which is how the U.S. is responding to the current terrorism threat--expanding the size of the Army and Marine Corps--but, because the cost of labor had gone up with the end of the draft, by investing in technology. There was enormous skepticism whether the U.S. could do this and get away with it. It was seen as too dangerous and risky by many groups.

The biggest skeptics were the Joint Chiefs of Staff. They wanted forces in being. The second biggest skeptics were defense critics, who were sure the new technologies would not work. There was actually an odd collusion between the anti-military crowd and the Joint Chiefs of that era, both arguing that the U.S. should not go down that road. We did go down that road. The size of the army was shrunk dramatically after the end of the draft, technology was substituted for it, and although we'll never know it would have worked in a European conflict, we certainly know that when we fought the 1991 Gulf War, all the technology did in fact work.

A simple framework to think about security, national security, and innovation is means: resources and things we can do. Using an expansive definition, we can get more people, we can throw more money at it; or soft power, if you believe in that. Then there's ends. Do you want to beat Russia, Germany, Japan, shape world order? Anything you could conceive of is an end. Technology can be seen as part of the calculated relationship between means and ends--i.e., strategy.

This simple model is useful because many people advance strategies--but can't say whether they will cost 4 or 24 percent of the GDP. Treating the means-ends distinction as some kind of technical detail, or ignoring it altogether, seems to me to be characteristic of the strategy discussion in the U.S. today.

In the offset strategy example, Secretaries Brown and Perry decided that the ends they wanted to achieve was to offset Soviet military power; the means were principally technology and the money to buy it. They got away with it because President Carter didn't want to buy anything. He was very interested in innovation as long as it didn't require purchasing military equipment. So the R&D was done under his administration, and when President Reagan took office, he was uninterested in studies and analysis but he wanted to buy force structure. It was the coincidence of the Reagan administration following the Carter administration that shows the complexity of technology policies.

LEAD USERS

The simple means-ends model described above is what in engineering or physics we would call a "canonical model or form." But there are other ways to look at the issues. What if the calculations between ends and means are too hard to actually do? Or, what if they are politicized? There's a different model for this. It's called Lead Users. This holds that the calculation is just too hard to figure out. You can't know what Congress is going to do, or what the future threat is going to be. So, just buy a technology, give it to people and see what they do with it. This is how the real world usually operates. Most U.S. military equipment has nothing to do with what it was originally bought for.

An example is nuclear weapons in the early part of the Cold War. Many studies were done about whether we would or could use them; if we used them against the USSR, would they fire back at us? Elaborate strategies of deterrence were developed. However, the way nuclear weapons were really used by Presidents Truman and Eisenhower had nothing whatsoever to do with the strategic literature. They were used to rattle the cage and increase risk when you were in a crisis, such as the Berlin crisis of 1948 and the Cuban missile crisis of 1962. Nuclear weapons were used; they just weren't detonated. The use of nuclear weapons which allowed the U.S. to win the Cold War with GDP defense budgets of 8-9 percent compared to the Soviet Union's 20-30 percent, ultimately bankrupting them, came not from any study. Things we would take for granted about deterrence, first- and second-strike capabilities, no one thought of them at all until we actually had nuclear weapons in our possession. Then, leaders figured out ways to "use" them.

Another example would be the Navy's use of cruise missiles, which were originally nuclear weapons. The Navy thought, these are great, we could use them instead of jets and fly bombs to targets much more cheaply.

So one alternative that happens all the time is Lead Users. How did the Linux computer software develop? People developed it on their own in the field. Studies have found that half of Linux has been developed by on-the-job programmers who should be programming what they're supposed to be programming; instead, they're developing Linux.

DISRUPTIVE TECHNOLOGIES

Another model is Disruptive Technologies. The term is widely used in the Pentagon, CIA, and industry today to mean a big game-changer. It's partly right to see the Apple iPod, for example, as a disruptive technology in consumer electronics because it blew apart the existing market structure of dominant players. But I want to go into this in a little more sophisticated way.

First, the Disruptive Technology argument has two parts. There are sustaining technologies and disruptive technologies. Who is being sustained? The industry leaders. Certain technologies reinforce the power of the industry leader. Others disrupt that position. They favor new upstart companies or countries that are trying to break into the big leagues. It's a scoring system about whether they are sustaining or disruptive technologies. Sustaining technologies that enhance the power of the U.S. military to fight and win wars like we won against Iraq in 1991 and in March 2003, at least until the counterinsurgency started in April 2003, include cheap integrated circuits, dense-wave division multiplexing (amplifying light beams and switching them in fiber optic lines), stealth, nanotechnology, quantum computing--these are areas where the Pentagon is putting its money today, both in terms of R&D and in terms of conceptualizing the future and what it means for the U.S. I would argue that cheap rockets and simple cruise missiles are disruptive technologies because if other countries such as China and Iran and non-state actors like Hezbollah get them, they're very simple to operate, do not cost a lot of money, and they make life horrible for the sustaining technology player, the U.S.

The Disruptive Technology argument is interesting because it doesn't just recognize game changers, it says there's a dimension to this which advantages some countries over others. We're putting technology into a larger management framework.

A second part of Disruptive Technologies argument is frequently overlooked when we discuss whether we're still ahead of China (which we are, on almost any technology). If you picture a gap between the position of the U.S. in military stock and a rising country coming up with Disruptive Technologies, it isn't the gap that the disruptive technology must fill, but only the gap up to a midpoint of what the customer needs. What will sell in the marketplace? As one national security example of this, China today is developing a very substantial military capability. Is the gap closing? No. When it comes to quantum computing, nanotechnology, dense-wave division multiplexing, we are way ahead of the Chinese. But the Chinese only need to reach some midway level, far short of this. If you take some old technologies like over-the-horizon radar and marry them to cruise missiles, you will in future years, many believe, be able to kill anything on the surface of the ocean. If you can find it, you can kill it. China today shoots up missiles which ask our GPS satellites, "Where am I?" They can then do a mid-course correction to come down into what they call a basket of space, say, with a U.S. aircraft carrier in it. In ten years, the Chinese may be able to kill any target in the western Pacific out to 2,000 miles.

This has enormous national security implications. Japan will be asking, what about us? Can the U.S. be a superpower but not operate in the western Pacific? You might say, would the Chinese really blow up an aircraft carrier? Well, I've played in war games where, when staff go in and ask the president for permission to move the aircraft carrier to Taiwan because there's a chance its personnel might be killed, with a loss of 4,000-5,000 lives, with a single shot that is non-nuclear, the president says "If I lose 5,000 people, I'm going to be really forced to escalate war, and I don't want to do that." So the decision is to hold back U.S. forces to Guam and Hawaii. This is very "interesting" from a Southeast Asian, Taiwanese or Japanese point of view.

So it's not the gap. If the Chinese have the ability to do this, they can be way behind in other advanced technologies. But there will be large geostrategic changes. That's the insight of this Disruptive Technology framework.

SIDEWISE TECHNOLOGIES

Sidewise Technologies is an idea I got from Bob Panero when I worked with him at the Hudson Institute many years ago. He suggested looking at technologies that come out of the developing world compared to those of the U.S. He observed that it was thought that all the good spots in the world for hydroelectric dams had been taken--big canyons behind which you could put a lake. But if you look at it, there's a tremendous potential for hydroelectric power with low-earth dams. It's just that Western engineers tend to think that a dam has to be 200 feet high with giant turbines.

The same logic is found with military innovation. It's still the atomic bomb causing the U.S. nightmarish problems, an old, mature technology of 1945. The atomic bombs the Pakistanis, Iranians and North Koreans are trying to develop are not very sophisticated. They're very primitive. But they go off. As to missiles, the U.S. would never invest in a SCUD missile, which has no guidance system. It shoots off and maybe it comes down somewhere, your own people are the ones who are mostly endangered. Saddam Hussein did invest in SCUD missiles, and fired 37 of them at Israel in 1991, destroying the myth of Israeli invincibility. You couldn't strike at Israel, or so it was believed. Iran is developing missiles that can reach well into Europe, and so Middle Eastern wars that used to involve Israel, the Golan Heights, the Gaza, have expanded to include Iraq, Iran, even Europe now, because the missile defense system the U.S. wants to build will be based in Poland and the Czech Republic. So technology dramatically changes military geography. Years ago, the Europeans could say, "We don't care about the Middle East. Ultimately, we'll feel sorry for Israel, but it doesn't affect us." The Shahab-3 of Iran will change that view.

Over-the-horizon radar, which China is using today, is like high-frequency radio waves that bend over the earth's horizon. It can be used to find big pieces of steel in the western Pacific, such as aircraft carriers. The U.S. deployed its first system in the 1960s,[1] but Sidewise Technologies like SCUDs and OTH radar get virtually no attention in the U.S. They don't advance the state of the art like quantum computing or other more sophisticated innovations. So they are ignored, to our peril.

There is no doubt that the U.S. has its hands full in Iraq now with IEDs and other primitive systems. How do we handle those? Do we do it in retail fashion, by expanding the Army and Marine Corps to go around to the world's slums to fight bad guys house to house? Or do we try to find other ways?

To summarize, the U.S., to pursue a strategy--the calculated relationship of large ends to means—intrinsically has used technology more than any other country in world history. The Offset strategy of the 1970s allowed us to literally reduce the size of our standing forces by a third with a capital investment, an astounding achievement. But it doesn't always work. If you can calculate what you're going to do, some will look to Lead User models. Then there's Disruptive Technology, which allows you to look at international politics and what other major countries are up to. The final model is the technologies that cause the U.S. nightmares, in recent years, Sidewise Technologies.

CONCLUSION

Teaching at a business school, I see the unbelievable transformative effect of technology. Within China recently, a U.S.

[1] William Thaler at the Naval Research Laboratory developed the first experimental system, MUSIC, in the 1950s; a greatly improved system, MADRE, was built in 1961. Cobra Mist, the first truly operational system, was built starting in the late 1960s by the U.S. and UK.

company, a world leader in heart valves, very sophisticated technologies, took in a Chinese joint venture partner, as one must do in China. They've been there three years and have just discovered that the Chinese company has made the first Chinese heart pacemaker. It is half the price of the U.S. system and looks to be more reliable. The U.S. company is asking itself, what are we going to do?

There are so many examples of this in global business. Does the same thing apply to nation-states? Can the blitz speed of strategic advantage, which we know exists in the world of multinational corporate competition, not apply at the nation-state level? My view is that it does apply. There's a very complex technology game going on among the U.S. and China. As well, the U.S. is trying to play India and Japan against China, using their national innovation systems.

Other countries don't need to close the gap, they just need to meet their own security needs. If the U.S. Navy and Air Force cannot operate in the western Pacific, this changes world order dramatically. Japan will need to decide what it's going to do—will it develop its own nuclear deterrent, independent of the U.S.? What will India do? What will the West Europeans do? Will they continue their non-action in the face of these changes? Technology can dramatically and quickly change world order, and it's happening as we speak.

Is the U.S. being outmaneuvered technologically? There are three areas where we're competing now: conventional, unconventional, and nuclear. In conventional warfare, if you put armored divisions against us, we will win very quickly with our air and ground power. Then there's the unconventional warfare the Israeli Winograd report discussed, which is semi-militarized organizations like Hezbollah getting better technology. Finally, there are now nine (and counting) countries getting the atom bomb. The U.S. investment, its overwhelming capital expenditures in its forces, centers mainly around conventional warfare. Over the past two decades this has caused a non-symmetric, unconventional reaction. If you are Hezbollah, you move in that direction, terrorism but trained with modern radio networks and weapons. If you're North Korea, Pakistan, Iran, and likely others you go nuclear. If Iran goes nuclear, Saudi Arabia and Turkey will not be far behind. So the investment of the rest of the world is opposite of the United States. We're so focused on the conventional high-tech systems, we're ignoring the other two areas and getting pinched and pressed by both sides.

One could draw a very complicated scenario space of how that happens and how different countries take different actions. There's no definitive answer to the final question, but it does show the central feature of technology embedded in a larger national security policy.

Paul Bracken is Professor of Management and Professor of Political Science at Yale University. He is a leading expert in global competition and the strategic application of technology in business and defense. His course, Strategy, Technology, and War, is one of the most popular classes in Yale College. Bracken's articles for FPRI's Orbis include Financial Warfare (Fall 2007), Thinking (Again) About Arms Control (Winter 2004) and The Structure of the Second Nuclear Age (Fall 2003). This essay is based on his May 12, 2008, lecture for FPRI in Philadelphia, the first of the Rocco Martino Lectures on Innovation, founded by FPRI Senior Fellow Rocco L. Martino in 2007 to promote studies and education in innovation.

FPRI, 1528 Walnut Street, Suite 610, Philadelphia, PA 19102-3684.
For information, contact Alan Luxenberg at 215-732-3774, ext. 105 or email fpri@fpri.org or visit us at www.fpri.org.