Technology, Violence, and Peace

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GLOSSARY

Artifact Individual piece of hardware.
Big Science Large-scale, bureaucratized scientific research.
Little Science Small-scale, low-cost scientific research by individuals or small groups.
Nonviolent Defense An alternative to military defense relying on nonviolent action by civilians.
R&D (Research and Development) Scientific research and technological design, modification, and testing.
Sabotage Violence against technology.
Technological System (or Technological Ensemble) Collection of technical and social systems built around a single focus.
Technological Vulnerability The risk that a technological system will break down due to a certain threat.
Technology Artifact and related social aspects.
Weapon A tool for inflicting violence.

TECHNOLOGIES have long been used as tools for violence, from clubs and swords to cluster bombs and precision-guided missiles. In a less obvious way, technologies are vital to creating or maintaining peace in a society. For example, ample provision of food and shelter involves many technologies for agriculture, construction, and transport. Technologies can also be used to support nonviolent action, as in the case of communication systems designed to thwart aggression or surveillance.

I. TECHNOLOGY

Technologies are commonly thought of as individual pieces of hardware, such as pens, cars, and computers. These can be called artifacts. These artifacts are never created or used in isolation from people. Instead, they are aspects of relationships between people and relationships between humans and the environment. For example, most pens are manufactured in factories and are the product of a long process of design. The materials used to manufacture the pen, such as steel and plastic, come from a prior process of mining and manufacture. The plants used to manufacture pens involve workers whose work is possible due to their own skills and training and is influenced by employers, governments, and labor markets. When using the pen, a writer depends on social skills, including literacy, and also on other artifacts such as paper. In these and many other ways, the pen as an artifact is embedded in many social worlds. The word "technology" can be used to refer to both the artifact and its associated social aspects.

All technologies are social in this sense. They are created by humans and used by humans in social contexts. Therefore, in order to understand technologies it is necessary to understand their social contexts, including violence, peace, and conflict.

Technologies can be used for many purposes. For example, electronic mail can be used by armies and peace groups. Even so, every technology is typically easier to use for some purposes than others. Electronic mail is easy to use for sending messages, but it doesn't even make sense to use it to hit someone over the head. Thus, although technologies are multifunctional, they are never neutral.

Weapons are tools for inflicting violence. A bare hand or foot can be used as a weapon, but today the most commonly used weapons are technologies such as knives, rifles, and bombers. It is true that weapons can be used for nonviolent purposes. For example, a grenade can be used as a paperweight and a fuel-air explosive can be used as a piece of art. It is even possible to caress someone with the barrel of a rifle. But it is far more common to use these technologies to inflict violence, since that is what they were designed for.

There are many different theories of technology; some are more useful for thinking about technology in relation to violence and peace than others. To treat technologies as inherently good or bad is not helpful, since technologies have multiple uses. A more common view is that technologies are neutral. It is true that many technologies can be used for both good and bad purposes, and for different purposes. But usually neutrality is taken to have a stronger meaning, such as that technologies are equally easy to use for different purposes, which is not helpful when comparing compact disks and cruise missiles. The approach taken here, a standard one in studies of technology, is that technologies are constructed for specific purposes and, as a result, are usually easier to use for those purposes. Users can choose and modify technologies for their own purposes but are constrained by the physical reality of artifacts and the inertia of associated social systems.

There is a lot of writing about the ways that society influences technologies. On the one side is the view that technologies are autonomous, following their own trajectories. On the other side is the view that technologies are largely determined by their origins and inevitably serve the purposes of their creators. A middle view is that technologies are "shaped" by the social conditions and groups that led to their creation but, once created, they can, within limits, be directly used or modified for other purposes.

It is conventional to think of humans and technologies as different categories: humans think, act, and design technologies, whereas technologies are not beings in the same sense. This conceptual division is breaking down somewhat as technologies take over more human functions ("thinking" by computers) and as technologies become part of humans (most dramatically as prostheses but more commonly as extensions of human senses and capabilities such as telephones for speaking and vehicles for moving). One perspective on technology is based on rejecting the conceptual distinction between humans and artifacts, referring to both as "actants" and analyzing the way different actants enroll support, resist change, and so forth. This perspective can provide a refreshing perspective on the dynamics of technological societies. Nevertheless, for the account here, a conventional picture is used distinguishing between artifacts and humans.

Technologies can be divided into two categories. First are those that are designed and most useful for violence and violent conflict. These are discussed in Section II. In the second category are all other technologies. The role of technologies in peace and nonviolent conflict is covered in Section III.

An overall conclusion is that each mode of dealing with conflict is associated with characteristic forms of technology. Some of the points raised in Sections II and III are summarized below.

Typical Technologies Associated with Methods of Dealing with Conflict

Military forces: tanks, ships, bombers, radar, nuclear weapons
Defensive-only military forces: fighter aircraft and other weapons that cannot be used for offense
Guerrilla forces: small arms
Nonviolent defense: network communication systems, self-reliant energy systems
Negotiation: (technologies are not crucial)

II. TECHNOLOGY FOR VIOLENT STRUGGLE

A. Technology and the History of War

The human species is distinctive for its tremendous use of tools—another word for technologies. A few other species make limited use of tools, but for humans it has long been impossible to imagine society without tools; everything from sticks for knocking fruit from trees to clothing, roads, and electricity. Probably from the earliest use of tools, humans have used them for inflicting violence, including rocks and pointed sticks to kill animals and, sometimes, to attack other humans. Quite simple tools can be used to inflict horrific violence, and even today some mass killings are carried out largely by clubs and spears.

Weapons can be used to kill and subjugate other people. A society with a more powerful weapon can use it to help conquer others. In societies without agriculture, there is little to gain economically by conquering other people. Conflict between such societies often serves to maintain social cohesion, maintaining the in-group against the out-group. Battles are largely ritualistic, with few individuals hurt or killed. The technologies used in such conflicts are largely adapted from those used to hunt animals. There is little incentive for developing new technologies of violence.

With the development of agriculture some thousands of years ago, a new dynamic appeared. Agriculture depended on knowledge and artifacts for understanding and controlling natural cycles of plant life and required greater control of social life; for example, to ensure that adequate amounts of food and seed were preserved over the winter months. Agriculture was accompanied by the development of greater social differentiation, with individuals specializing in tasks such as producing agricultural implements and constructing major buildings. Agriculture made possible a greater surplus of food and goods, allowing some, such as priests, to live off the work of others. The gradual improvement of agricultural technology created greater surpluses, allowing more specialized roles and enabling innovation in other areas such as building.

With agriculture's greater surpluses came the possibility of attacking and subjugating another society in order to control that society and use its surpluses. This situation stimulated the production of weapons of attack and, in response, weapons of defense. The refining of new metals such as bronze and iron was used for producing more effective spears and arrows and, in defense, shields and armor.

For the past several thousand years, military priorities have played a significant role in technological development. For example, many early European cities were designed so that they could be defended against invaders, with a central area surrounded by city walls. Many inventors, such as Archimedes and Leonardo da Vinci, worked at developing more potent weapons.

On the other hand, technologies have repeatedly transformed the nature of warfare. The machine gun, for example, developed in the latter half of the 1800s, made it possible to overwhelm an opponent armed only with rifles. The British military used machine guns in defeating much larger forces in many of its colonial wars. In World War I, the machine gun gave a decisive advantage to the defense, and millions of men were killed in futile attempts to storm positions defended by machine guns. The development of the armored tank, in contrast, was a great advantage to the attacking side, used most decisively in early German victories in World War II. Since then, the development of nuclear weapons and long-distance delivery by bombers and missiles has created a mode of war preparation based on "deterrence," namely the threat to retaliate against attack with massive nuclear destruction.

These are only a few examples of the historical role of weapons. As technologies designed and mainly used for violence, weapons have played a key role in social evolution. Even those technologies that seem "peaceful," such as roads and factories, have been influenced by military priorities. More importantly, though, technologies have made possible ever-more-destructive forms of warfare.

B. Types of Technology Used for Violence

There are various ways to classify technologies used for violence. Military forces are commonly divided into the branches of army, navy, and air force. Each has its own characteristic types of technology. Army: jeeps, tanks, cannons, ground-launched missiles; navy: destroyers, battleships, submarines, sea-launched missiles; air force: fighters, bombers, air-launched missiles.

Only some technologies are really specific to these branches. Machine guns and explosives are used by all of them. Missiles are much the same whether launched from ground, sea, or air. In the former Soviet Union, a fourth branch of the military was the "missile forces."

Another way to classify weapons is by the primary means by which they cause destruction. Four categories are normally used.

1. Nuclear weapons, sometimes called atomic weapons, are explosives whose power comes from fission and/or fusion reactions involving atomic nuclei. Their effects include blast, heat, and radiation. Some radiation is short term, including neutrons, whose effect is enhanced in nuclear weapons called neutron bombs. Other radiation, especially fallout, is long term. It is also possible to have radiological weapons based on radiation from nuclear sources in the absence of an explosion.

2. Chemical weapons are chemicals, such as napalm and sarin, that wound or kill by direct contact with humans. They can be delivered in various ways such as by artillery shells or missiles.

3. Biological weapons are disease organisms, such as anthrax, that cause illness or death in humans.

Like chemical weapons, they can be delivered in various ways.

4. "Conventional" weapons are traditional weapons such as rifles and explosives. The explosive force behind these weapons is usually based on chemical reactions. But they are not called chemical weapons because they cause destruction primarily by physical processes, such as when a body is hit by a bullet or by shell fragments from a grenade, land mine, or artillery shell.

As well as nuclear, chemical, biological, and conventional weapons, there are also some other categories. So-called environmental weapons are based on triggering natural processes, such as earthquakes and tidal waves, by artificial means such as explosives.

Another important category is the "technology of repression," namely technologies used for torture, incarceration, area control, and surveillance. If military aggression is the use of force to attack, repression is the use of force to control. The technology of repression includes electroshock devices, leg shackles, trauma-inducing drugs, guillotines, plastic bullets, chemical irritants, night vision cameras, automatic vehicle tracking systems, telephone-tapping equipment, and human identity recognition systems. It also includes associated systems for production, skills, and training to use such equipment, including technical support and training in interrogation, torture, and assassination. Some of the technologies used for repression are just different uses of everyday technologies, such as cigarettes or electrical circuits used in torture or computer databases used to keep tabs on dissidents. Others are specially designed for the purpose, such as prefragmented exploding ammunition.

"Nonlethal weapons" are weapons designed not to kill or maim. They include electrical stunners, infrasound beams to cause disorientation, and chemical sprays. Many nonlethal weapons are used for repression.

Weapons are an important part of the technology of violence, but weapons can only exist if there are other technological support systems. Here are some of the components.

- Industrial systems are used to produce most weapons today. For example, artillery shells are produced in factories. This in turn requires designing and building the factory itself, training the workers, inspecting the products (quality control), and adapting to new specifications.
- Transport systems are needed to get weapons to battlefields, to move troops, and to serve the requirements of industrial systems.
- Communication systems are needed to plan and coordinate military operations, to gain information about enemy activities, and to coordinate industrial production.
- Various support systems are needed to sustain military operations. These include agriculture to produce food, energy to power transport and industry, and others including water, sewage, and medical services. In so-called "total war," such as World War II, nearly every sector of society is mobilized to support the war effort, including clothing workers, teachers, and artists. Technology plays a role in every sector in society and thus is implicated in the social mobilization for total war.
- "Weapons systems" are the full complexes of technologies that support a particular weapon. For example, a jet aircraft on its own is almost useless. It requires, among other things, fuel supply systems; regular and often intensive maintenance; spare parts; landing fields; weapons (such as missiles); training facilities for pilots; and research and development (R&D) efforts to design, build, and test the aircraft.

All weapons need to be understood in the context of associated technological and social systems. Even an apparently simple item such as a bullet exists only because of a complex of technological systems. So rather than referring to an artifact or a technology, sometimes it is useful to refer to a "technological ensemble," which is the full collection of technical and social systems built around a single focus. Rather than think of a submarine as an isolated piece of technology, it is helpful to think of it as a technological ensemble involving systems for design, manufacture, maintenance, communication, supply, training, and many other functions.

C. Characteristics of Technology Used for Violence

Since technologies have many potential uses, there is no definitive way to characterize technologies used for violence. Nevertheless, there are some criteria that provide insight.

1. Destructive Power

Weapons are typically oriented to destruction. Some bullets are designed to wobble in flight so that they destroy much larger amounts of human flesh. Fuel-air explosives are designed to maximize the destructive power of conventional chemical components; some of them have the explosive power of a small nuclear weapon.

However, destructive power alone does not distinguish a weapon from a nonweapon. For example, explosives used in mining can be extremely powerful.

2. Centralized Control

The ideal military weapon is one that can be totally controlled by the user but cannot be controlled—that is, resisted or evaded—by the enemy. Land mines, for example, are laid at the discretion of the user but are designed to be difficult to detect and defuse by others. A cruise missile, once launched, is extremely difficult to intercept and destroy before reaching its target.

Centralized control might be a military ideal, but it is never achieved. One problem is that other militaries often can obtain the same weapons. Both sides can use land mines and cruise missiles. Even nuclear weapons, subject to the tightest controls, cannot be monopolized. Many governments have developed them, and there remains the possibility of criminal or terrorist use.

Centralized control is not just a military goal. Many corporations, for example, seek to control production of goods, for example through secrecy and patents. As well, some types of weapons, such as guns, are widely available in at least some countries. Centralized control thus is a characteristic of some weapons systems but by itself does not distinguish weapons from nonweapons.

3. Offensive versus Defensive Weapons

It is common to distinguish between offense and defense in military operations, though often both sides claim to be defending rather than attacking. Technologies can be classified according to whether they are useful for offense. Technologies of offense include bombers and intercontinental ballistic missiles. Technologies that are not so useful for attack include fortifications, bomb shelters, antiaircraft artillery, and short-range fighter aircraft. A military system based around technologies that cannot easily be used for attack is called "nonoffensive defense" or "defensive defense."

Offensive weapons are often justified on the basis that they will deter attack. The classic case is nuclear deterrence, based on the threat to destroy enemy facilities or population centers if the enemy launches an attack.

4. Participation

When lots of people can use a technology it can be called "participatory." Some weapons are participatory, such as knives and rifles, whereas others are not, such as battleships and tanks. The most participatory weapons are those that can be used by individuals without much training and which can be cheaply produced in large numbers. For mass armies, from the French Revolution to the Iraq–Iran war in the 1980s, participatory weapons are commonly used. However, the trend in military R&D is to develop weapons that are less participatory, such as submarines and supersonic aircraft.

Two contrasting modes of warfare are (a) regular military forces led by and sometimes composed entirely of full-time professional soldiers and (b) guerrilla forces, which are "irregular" fighters typically operating by harassment and typically against regular forces that have standard large-scale equipment and control of major transport routes. Guerrillas are often drawn from the local population and have little formal military training. As a result, guerrillas typically use more participatory weapons such as rifles, traps, and explosives. This is partly due to the need to escape detection (a jet fighter is hard to conceal), partly due to lack of resources, and partly due to lack of skills and support personnel to maintain complex weapons systems. However, with the development of sophisticated small weapons that can be purchased more or less "ready to use," such as portable rocket-launchers, some guerrilla forces are upgrading their weapons. When guerrilla forces are successful militarily and begin to control substantial areas, typically they also acquire more large-scale military equipment.

It would be quite possible to produce vast numbers of deadly weapons that anyone could use, but few governments seek to arm their populations when it is not wartime. Those that do or have—most notably Switzerland, Sweden, and former Yugoslavia—usually restrict people to hand weapons such as rifles and do not routinely make available grenades, bazookas, land mines, nerve gases, or mobile missile launchers, though they may be trained in using some of these.

D. Gender and Technologies of Violence

Males carry out most of the physical violence in the world, both at an individual level and at an organized level, especially violence by militaries. Military and police forces are predominantly male, especially so in front-line positions. Since male domination is closely associated with violence and with the institutions—namely the police and the military—that are authorized by the state to use violence, it is to be expected that there might be some relation between gender and technologies of violence.

Some technologies for violence are designed for men, who tend to be larger and stronger than women. Many weapons, such as heavy swords and guns, are difficult to use for those who are small or relatively weak and thus are oriented to men. But this connection is not a tight one, since some women are larger and stronger than many men. It is better to say that such technologies are designed for certain types of people—those of a certain size and strength. These technologies are designed for young fit men, who are more likely to be selected for the military and police, and are hard to use by most women as well as by children, the elderly, people with disabilities, and men who don't fit the standard model.

It is quite possible to design many technologies so that size and strength do not affect one's ability to them. Pressing the buttons to launch nuclear weapons does not require any special size or strength. As soon as weapons become mechanically powered and automated, strength is largely irrelevant, and so in principle gender should become irrelevant. Yet gender divisions remain extremely strong even in the most technologically sophisticated military forces, especially in the production and use of weapons.

Gendered work roles are quite pronounced in factories, including weapons factories. Production work with certain technologies is conceived as a male domain, but the definition of what is a male task changes with time. For example, in the early days of the typewriter, typing was considered a male task. Later it became an overwhelmingly female area of employment. With the spread of word processors, it is more common for both sexes to use keyboards. A similar pattern is apparent in many areas involving weapons. Certain technologies are defined as male or female domains, even though in many cases there appears to be no objective reason for this assignment.

The patterns of gendered use of weapons suggest that male domination often shapes production and use of technologies of violence more than military efficiency. Militaries remain largely composed of young fit men even in highly technological forces where women and other poorly represented groups could be equally or more effective in the roles. In these situations, some technologies are gendered by design, but the most important factor is the imposition of gendered identities and uses on technologies.

E. Violence, Technology, and Social Organization

Through the ages, warfare has affected the way that societies are organized. One example is the rise of the modern state in Europe. Governments sought to maintain large standing armies in order to defend against enemies and needed new sources of money to pay the soldiers. New bureaucracies were established to collect taxes; the military was used to compel compliance. Warfare was thus integral to the development of the modern bureaucratized state.

In a few cases, the role of technology in such military-influenced social changes can be seen. For example, during the 1800s some railway lines in Europe were built so that they could transport troops to front lines. The pattern of railway development in turn influenced commercial transport.

With the rise of total warfare in the 1900s, the entire economic system is mobilized for war. This has led to the imposition of a command economy by governments, with centralized control over investments, distribution, and labor. During World War II, command economies were imposed in England and the United States as well as in the dictatorships of the Soviet Union and Nazi Germany where government control was already substantial. To run a command economy, it is helpful for military production to be organized in large factories, whose activities are easier to control centrally than production that is dispersed geographically and organizationally. Since the military itself runs on a command system, it might be said, then, that factory production fits into a military model. At a very general level, there are affinities between the military, as an organization of humans and technologies to exercise force, and factories, as command systems for industrial production.

Technologies of violence can also influence social relationships at a more intimate level. In societies where guns are routinely used for crime, people who are afraid are more likely to stay home and barricade themselves behind locked doors and windows. Although it is quite possible to attack someone with bare fists, various technologies, including shoes, brass knuckles, knives, and guns, increase the potential harm from assault. This in turn triggers technological development for protection or retaliation, ranging from alarms, bullet-proof vests, incapacitating sprays, and guns.

Technologies used for violence thus are implicated in the way people relate to each other at the face-to-face level as well as in the organization of factories, transport, and energy systems. But there has not been much study of these connections, so it is difficult to make definite conclusions about the connections between technologies and social organization.

F. Science, Engineering, and Technologies for Violence

Technologies are based on human manipulation, construction, and organization of materials. Engineering is a field whose primary activity is designing, developing, and maintaining technologies. Similarly, knowledge is based on human construction and organization of ideas. Science is a field whose primary activity is developing and testing knowledge about the natural world.

Before the 1900s, technological development, including weapons development, was primarily a matter of practical insight combined with trial and error. Early scientific theories seldom were used by inventors or manufacturers. Instead, often it was technological innovation that stimulated scientific theory. For example, science contributed little to the development of the steam engine, whereas the practical reality of the steam engine triggered the development of the laws of thermodynamics.

Beginning in the late 1800s, this situation began to change. In the German chemical industry, for example, scientific knowledge about synthesis of chemicals was used in developing systems for manufacturing them. In the years since, there has been an ever closer interaction between scientific knowledge and technological development, each being used to stimulate the other. For example, theoretical investigations into the field of numerical analysis (a branch of mathematics) sometimes have spin-offs in practical applications; at the same time, practical developments in computing sometimes stimulate new theoretical investigations. The interaction between knowledge and technology is so routine that it can be misleading to distinguish between them. Although terms such as "scitech" have not caught on, the word "technology" today often implies the involvement of science and the word "science" assumes a role for technology. This is true of weapons as much as anything else.

In the past century, weapons design, development, and production has become a carefully planned process involving scientific and engineering expertise. The single most important event in the mobilization of science and engineering for war and violence was World War II, during which time scientists and engineers in many countries—including Britain, Germany, the Soviet Union, and the United States—were put to work to aid the war effort. This led to rapid developments in many areas, including ballistics, explosives, manufacturing processes, cryptography (the study of codes), radar, and, most famously, nuclear weapons.

To be sure, scientists had applied their talents to war-making on many previous occasions. World War II was a turning point in that, for the first time, many governments systematically organized scientific talent for the purpose of making war. The most important case was the U.S. Manhattan Project, set up to produce nuclear weapons. This involved hundreds of top scientists and engineers, massive expenditure, and the establishment of organizational structures to harness intellectual and technical work for military purposes.

After the war, the military mobilization of science and engineering continued, often justified by the imperatives of the Cold War between the United States and the Soviet Union and their respective allies. Governments poured massive amounts of funding into science and engineering, much of it directly into military projects and much of the rest into areas with potential military spin-offs, such as microelectronics, meteorology, oceanography, and aeronautics. World War II thus symbolized a transition from "little science" to "big science." Little science was characterized by small projects run on a low budget by one or just a few scientists, often carried out by amateurs or university professors. Big science, by contrast, is characterized by large-scale projects with mammoth budgets and involving dozens or hundreds of scientists, typically funded by government or sometimes by industry.

One of the important features of big science is its bureaucratic nature. Whereas little science was—and still is to some extent—done at the initiative of individuals who relate to colleagues in their field as independent professionals, big science involves large teams organized bureaucratically, with direction from the top, both from funders and team leaders. The transition to big science was brought about largely by military projects, but now many civilian research enterprises are also run on the same lines.

In the United States, most military funding comes from the federal government but much of the R&D is carried out by industry, such as by automobile, aircraft, and chemical companies. The close link between military and industry is called the "military–industrial complex," a term that indicates the mobilization of industrial enterprises for military purposes and has also been referred to as "Pentagon capitalism." The application of science and technology for violence is central to the military–industrial complex, which is sometimes therefore called the scientific–military–industrial complex. Similar complexes are found in major arms-producing capitalist countries, such as Britain, France, Germany, Italy, and Switzerland. In the former Soviet Union, on the other hand, industry was run directly by the government and the term is not so relevant.

In bureaucratized military R&D, individual scientist and engineers are cogs in a large enterprise. Often they work on specific tasks, such as some detailed aspect of developing a computer program or a propulsion system, which seems to have little immediate relevance to military purposes. Scientists are primarily problem-solvers and engineers are primarily makers, and they can carry out their tasks with little or no awareness of the end products and larger context of which their work is a part. This is similar to the factory worker on an assembly line whose narrow tasks are much the same whether the product is a car or an armored personnel carrier. Bureaucratic organization and large-scale projects thus help to insulate many scientists and engineers from the ultimate uses of the things they help produce.

G. Technological Vulnerability

Today's technological societies are remarkably vulnerable to breakdown or sabotage. Disabling a few key power stations and transmission lines could cripple electricity supplies; computer viruses can disable communication networks; deadly toxins in central water supplies could kill vast numbers of people. These technological vulnerabilities are especially acute in the case of military attack. A few bombs on key industrial facilities or communication nodes would be devastating. A single nuclear power plant, if targeted for attack, could release massive quantities of radiation into neighboring areas.

The only way to defend against attack on crucial facilities, it seems, is by military preparedness that will stop any aggressor at a country's borders or before. Since missiles can now penetrate many defenses, this becomes an argument for deterrence, namely developing the capacity and making the threat of counterattack in force. Technological vulnerabilities thus provide a justification for "forward defense," namely the capacity for military offense.

One way to reduce technological vulnerabilities is to create differently structured technological systems, often decentralized ones. An energy system based around energy efficiency and local renewable energy sources, for example, is far less vulnerable to a few bombs or saboteurs than centralized power sources. The Internet—which was originally designed by the military to survive a nuclear attack—is far less vulnerable to attack or military coup than a small number of large television and radio stations. Technological systems based on networks, self-reliance, and low hazard are generally more resilient in the face of attack than centralized, expert-dependent, and potentially risky systems.

The issue of technological vulnerability illustrates how technological choice even in ostensibly nonmilitary areas can affect the need for military defense. Large-scale military weapons systems, including aircraft carriers, nuclear submarines, and ICBMs, are themselves prime vulnerabilities in the event of war and thus help justify their own existence.

III. TECHNOLOGY FOR PEACE AND NONVIOLENT STRUGGLE

Advocates of military defense sometimes argue that weapons—including weapons of mass destruction—are technologies for peace, since they operate to deter attack by enemies. Whatever one's assessment of this viewpoint, weapons are technologies for violence. In this section the focus is on technologies that are not designed for violence. Some of these are especially useful for preventing war; others are especially useful for dealing with conflict using nonviolent means or, in other words, waging nonviolent struggle.

A. Technology for Arms Control

When governments enter into treaties or agreements to control their armaments, there is often a suspicion that the other side might be cheating. One way to monitor treaties is by direct inspection of the other side's military facilities, but sometimes that is banned or restricted on the grounds that military secrets might be revealed. Another approach is to use technological means for monitoring compliance.

One example concerns the testing of nuclear weapons, which many militaries desire in order to ensure that their arsenals will work. In the 1940s and 1950s, atmospheric nuclear explosions could be detected by monitoring the levels of radiation in the atmosphere. Since the 1960s, earth-orbiting satellites have been used to look for tell-tale characteristics of nuclear explosions. When some governments agreed that all underground nuclear tests larger than a certain strength would be prohibited, compliance was checked by sensitive seismic equipment that can detect tremors in the earth at great distances.

Monitoring technologies are the most common ones used for arms control. Monitoring technologies are commonly used for military purposes, as in the case of surveillance satellites, but can be readily turned to the task of providing information to those aiming to limit the deployment or testing of weapons.

B. Economic Conversion

When technologies are changed from military production to civilian production, this is called "economic conversion" or "peace conversion." It has long been a routine occurrence in the aftermath of wars. Factories that produced jeeps are converted to produce cars, and facilities used to produce military electronics are converted to produce civilian electronics. Economic conversion is the opposite of military conversion, which routinely occurs before and during wars as economies are mobilized to support the military struggle.

Economic conversion is not just a matter of changing production from weapons to civilian goods. It involves a host of factors, including retooling of production facilities, designing products appropriate for civilian use, and retraining workers. One important change is in the market for goods produced. Much military-related production is made to order according to military specifications with a guaranteed purchaser: the military itself. For civilian production, sales are often less predictable. A different mindset is needed for competing in the market.

Up to and including the aftermath of World War II, economic conversion was not too difficult since factories that produced military goods relied on basic manufacturing processes such as metalworking. In recent decades, though, military technologies have become far more military specific. Today, many weapons are so highly specialized that it is far more difficult to convert facilities that civilian purposes. For example, facilities that produce missiles or nuclear submarines have few immediate civilian applications. This applies as much to the skills of scientists and engineers as it does to the actual buildings and equipment.

Even when military facilities can be converted, they lead down certain technological paths. For example, military aircraft engineers might turn their skills to high-speed mass transit; their skills and orientation are less likely to lead them to designing bicycles or cycleways. The result is that some civilian technologies and priorities are influenced by a past history of military investment. The most notable example is the push for nuclear power which drew heavily on personnel, skills, and commitments originally developed to produce nuclear weapons.

Many local communities and peace activists have devoted huge efforts at making economic conversion work. In many cases the task is enormous. The difficulties are in part a consequence of what can be called "technological momentum." The investments in military facilities create a continuing incentive—a momentum—to maintain themselves. This is partly due to the physical infrastructure of buildings and tools, partly due to the investment in training and development of skills, and partly due to workers and local communities developing ways of living that are tied to the facilities. Technologies by themselves do not perpetuate themselves, but humans can develop a strong adherence to behaviors that are linked to continuing the established technological framework. The more militarized the technological infrastructure, the greater the difficulty of economic conversion.

C. Technology for Nonviolent Action

Conflict can be waged by both violent and nonviolent means. The role of technology in violent struggle is well known, but technology can also play an important role in nonviolent action.

Some methods of resolving conflict, such as mediation and arbitration, are essentially human techniques. Technology such as pens, charts, or videoconferencing facilities can play a supportive role, but it is seldom vital to the success of such methods. Technology is more fundamental to what is called nonviolent action or nonviolent struggle.

Methods of nonviolent action include symbolic actions such as speeches, rallies, and marches; noncooperation such as boycotts and strikes; and interventions such as fasts and sit-ins. When thinking about methods such as speeches, strikes, or sit-ins, the main focus is on human bodies; technology seems incidental, such as the microphones used by a speaker. This is partly because activists have not paid much attention to the role of technology in waging nonviolent struggle.

1. Technology for Nonviolent Defense

To illustrate the role that technology can play in nonviolent action, it is useful to consider the case of defense against aggression or repression using nonviolent means. This is called nonviolent defense, social defense, civilian defense, or civilian-based defense. It is the application of the methods of nonviolent action for defending a community from military attack or authoritarian rule.

There are several factors that are important for the success of nonviolent defense. The most crucial are psychological and organizational factors, including the morale, unity, and will of the nonviolent resistance; the knowledge, understanding, and strategy of the resistance; and the coordination, decision-making, and leadership of the resistance. To improve the capacity of the resistance in these areas, psychological and sociological research and testing is valuable. Technology is not central to these areas.

Another set of factors, under the general heading of physical infrastructure, is also important. This includes communication systems; industrial production and distribution; and systems ensuring human survival, including food, water, clothing, shelter, energy, transport, and health. Technology is heavily involved in all these areas.

2. Communication Technology for Nonviolent Defense

Consider communication, probably the most important factor in nonviolent defense involving technology. An aggressor normally seeks to control means of communication. In a military coup, the first targets are television and radio stations. If a population is dependent on mass media—television, radio, and major newspapers—for information, it is vulnerable to political control by a small group. For effective communication in a nonviolent struggle, it is far better to use network media, including the mail service, telephone, fax, short-wave radio, and electronic mail. All of these use technology to enable one-to-one interaction. If there is a dense network of network media, then it becomes very difficult for a ruler to control the population.

After the Indonesian invasion of East Timor in 1975, the occupying forces tried to prevent any communication with the rest of the world. The Australian government aided this effort by shutting down a radio transmitter in the Northern Territory that was a link to the East Timorese resistance (which included both nonviolent and armed guerrilla components). In 1991, a journalist was able to film some of the brutal actions of the Indonesian military and smuggle a video out of the country. The subsequent worldwide publicity greatly helped the East Timorese cause.

After the Chinese government crushed the prodemocracy movement in Beijing in 1989, it publicized a phone line for citizens to inform on those who were involved in the movement. Prodemocracy supporters were able to communicate with supporters outside China using fax machines, which were not controlled centrally. Numerous callers around the world called the phone line in order to block its use by the Chinese government.

These are examples of how communication technology is crucial to nonviolent action. Just as R&D is vital in developing military technologies, so too is it vital in improving communication technology for nonviolent purposes. For example, telephone systems can now be monitored centrally, making it relatively easy for a repressive government to listen in or disrupt particular lines. In a nonviolent defense system, telephone systems would be designed so that central monitoring is either impossible or is able to be disabled in a crisis.

3. Survival Technology for Nonviolent Defense

Other technological systems vital to a nonviolent resistance are those that enable survival of the population. If the food supply, for example, is heavily dependent on fertilizers, pesticides, and transport systems, then it is possible to punish a population that refuses to acquiesce by disrupting food production and distribution. The food supply is less vulnerable to disruption if it relies more on local gardens. Rather than develop knowledge, skills, and technologies for monocultures and large-scale harvesting, the orientation would be toward knowledge, skills, and technologies to develop fruit-bearing trees, plants that are easy to cultivate in small local gardens, and convenient means of preserving food, among other possibilities. In the intifada, the unarmed Palestinian resistance to Israeli rule from 1987–1993, local food production was important, since the Israeli occupiers often punished the population by imposing long curfews, banning travel, and closing shops.

The basic strategy behind a physical infrastructure to support nonviolent action is to improve self-reliance of the population. This includes systems for energy, water, transport, and health.

In the case of industry, an aggressor may wish to run factories for its own purposes. It would be possible to design equipment so that it can be disabled by the workers in case of an emergency. For example, crucial software could be written that would irreversibly scramble the computer operating system if a suitable number of workers anonymously keyed in special individual codes. A back-up system could be stored safely, for example, in another country. With such a system, the workers could not be forced to get the system going, since they would lack the technical ability. In a sense, the resistance would be built into the technology.

4. R&D Priorities for Nonviolent Defense

The priorities for R&D for a system of nonviolent defense would be quite different from those for a military system. Military funding and priorities have helped shape the strong research emphasis on the natural sciences and engineering, which are especially relevant to weapons systems. In contrast, R&D for nonviolent defense would place much more emphasis on the social sciences, since factors such as morale, strategy, and coordination are central to organized nonviolent struggle.

A reorientation to nonviolent defense would also change the emphasis within numerous fields of study. Within materials engineering for example, the emphasis would shift from materials that can be used in weapons to materials that could be used by a people to build their own houses easily and simply. Within psychology, the emphasis would shift from ways to make soldiers more ready and able to kill during combat to ways to help nonviolent resisters sustain their commitment in the face of divide-and-conquer tactics. These are crude examples of how a shift of research priorities from military to nonviolent goals would change the problems studied, the knowledge gained, and the technologies developed.

5. Participation in R&D for Nonviolent Defense

The process of studying and developing technologies for nonviolent action provides a contrast to weapons R&D. Most military R&D is carried out by government or corporate laboratories, with scientists and engineers taking a leading role. Testing is done in labs and by the military itself, in exercises and on the battlefield. Thus, the whole process of military R&D is dominated by specialists, including scientists, engineers, and military personnel.

In contrast to this military model, nonviolent defense depends fundamentally on popular participation. Whereas most soldiers are young fit men, anyone can attend a rally or join a boycott, with few restrictions on the basis of age, sex, or ability. Furthermore, the success of nonviolent defense depends on widespread participation. As a general rule, technologies supportive of nonviolent action are those that allow or foster participation, such as telephones and faxes for communication or do-it-yourself building materials. This is because dependence on centralized facilities or on a small group of specialists makes a society vulnerable to takeover.

The implication is that development and testing of technologies for nonviolent defense also needs to involve as wide a cross section of the population as possible. For example, in designing a cheap and easy-to-use short-wave radio system, it makes sense to consider designs by many different users and to have lots of people try them out. When actually implementing a system of short-wave sets, it would help to run small-scale tests and full-scale simulations, analogous to military exercises. Whereas military training normally only involves military personnel, training for nonviolent defense would need to involve the entire population. The same applies to the process of developing appropriate technologies.

In summary, reorienting technology from military priorities to the goal of supporting nonviolent action has major implications for several dimensions of R&D. The fields that receive the greatest attention and support would change: military-generated interest in engineering and the physical sciences would be replaced by nonviolence-generated interest in the social sciences. Within particular fields, the key problems would also change. Within architecture, for example, a key goal might be how to encourage the social solidarity that is vital to nonviolent action. Finally, the methods of R&D would change to become far more participatory. These implications show that the military influence on science and technology is deep and pervasive. It involves not just the technologies that are produced but also theories, intellectual priorities, technical training, skills, and research methods.

D. Sabotage

Sabotage can be considered violence against technology rather than against people. It includes actions such as putting sand in a tractor's fuel tank, programming a bug into a computer system, and putting spikes in trees that will wreck a sawmill blade. Sabotage is often covert, such as when a worker physically halts an assembly line.

Sabotage has been used to resist aggressors, such as by factory workers in Europe occupied by the Nazis. It is also commonly used by workers to resist their bosses, for example as a form of protest against production increases. Some environmental activists use sabotage to try to stop activities such as mining and forestry.

Sabotage occupies a position somewhere between violence and nonviolence. It can be used as part of a violent or a nonviolent resistance to aggression or repression. Some types of sabotage are visibly violent, such as blowing up buildings, whereas others are much less overtly damaging, such as deleting a computer file containing names of dissidents targeted for arrest. There have been many debates about the morality and pragmatic value of sabotage. In terms of the role of technology in conflict, the distinctive feature of sabotage is that it involves disabling a technology rather than using it for the purpose it was designed for. It is also possible to have sabotage of social and knowledge systems associated with technologies, such as the disruption of military training exercises. Propaganda and disinformation can be considered to be methods of sabotage in which the target is people's beliefs rather than technologies.

Although much sabotage is covert, some is open, such as when activists hammer nosecones of nuclear missiles or pour blood on military files and then wait to be arrested. In these principled sabotage actions, the symbolism of damaging technologies is of far greater significance than the actual physical damage. This sort of sabotage highlights the dual role of all sabotage, namely in actually damaging or hindering technologies and in symbolizing the existence of resistance to those using or running the technologies.

E. Strategies for Moving toward Technology Oriented to Nonviolent Action

The systems for designing, producing, and maintaining technologies are powerful. Societies have made enormous investments in current technologies, including everything from bricks and roads to pharmaceuticals and satellites. These "investments" include factories, physical infrastructure, systems of knowledge, training, bureaucratic routines, and regular ways of doing things. Therefore it is a mammoth task to transform these systems to reorient them in support of nonviolent action.

The easiest and most productive step is to find those technologies that already exist that can be used for nonviolent action and to encourage more people to use them for this purpose. Electronic mail, for example, is excellent for communicating in the face of repression. More people could learn how to do this and in particular learn tricks to reduce the vulnerability of e-mail being cut-off or monitored. Also, using e-mail to make contact with activists who oppose repressive regimes can be done immediately.

The next easiest step is to investigate options for using existing technologies. This could be done by searching publications or by talking to knowledgeable individuals. Through such an investigation, it might be found that there already exist procedures for protecting e-mail systems from takeover, such as using a duplicate password system.

Somewhat more difficult is to push for minor adaptations to existing technologies to make them more useful for nonviolent action. An example is the development of special software to run e-mail systems in a crisis, reducing the vulnerability of the system at central nodes of control.

Finally, there is the option of developing entirely new technologies, such as new ways of running e-mail. This is likely to require the most effort for the least return since, even after developing a good system, it would be necessary to convince people to adopt it. Nevertheless, if technological systems are ever to be transformed from military to peaceful priorities, then R&D will have to be reoriented as well.

Fundamental to any of these changes is a greater awareness of the importance of designing and using technology for creating a society based on nonviolent rather than on violent modes of conflict. If existing technologies are just treated as a backdrop to action for peace, then a whole dimension of change is overlooked. A strategy for peace needs to include a policy for technology.

Also See the Following Articles

ARMS CONTROL • ECONOMIC CONVERSION • ECONOMICS OF WAR AND PEACE • MILITARY-INDUSTRIAL COMPLEX • NONVIOLENT ACTION • WARFARE, TRENDS IN • WEAPONRY, EVOLUTION OF

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