



## INDUSTRIAL BASE TECHNOLOGY LIST

The Defense Security Service-developed Industrial Base Technology List (IBTL) is a compendium of the science and technology capabilities under development worldwide that have the potential to significantly enhance or degrade U.S. Military capabilities in the future. IBTL categories are correlated with legacy Military Critical Technology List (MCTL) categories below (noted in italicized font).

Click each category for a more detailed description.

<b>Command, control, communication, and computers (C4), Information Security</b>	<b>Energy Systems, Energy Systems</b>
<b>Software, Information Security</b>	<b>Electronics, Electronics</b>
<b>Lasers, Lasers, Optics, and Sensors</b>	<b>Manufacturing Equipment and Manufacturing Processes, Processing and Manufacturing</b>
<b>Optics, Lasers, Optics, and Sensors</b>	<b>Positioning, Navigation, and Time, Positioning, Navigation, and Time</b>
<b>Sensors (Acoustic), Lasers, Optics, and Sensors</b>	<b>Signature Control</b>
<b>Radars, Lasers, Optics, and Sensors</b>	<b>Materials: Raw &amp; Processed, Materials and Processes</b>
<b>Ground Systems, Ground Systems</b>	<b>Agricultural</b>
<b>Aeronautic Systems, Aeronautic Systems</b>	<b>Medical, Biomedical</b>
<b>Marine Systems, Marine Systems</b>	<b>Nanotechnology</b>
<b>Space Systems, Space Systems</b>	<b>Synthetic Biology</b>
<b>Nuclear, Nuclear</b>	<b>Energetic Materials, Armaments and Energetics</b>
<b>Biological, Biological and Biomedical</b>	<b>Quantum Systems</b>
<b>Chemical, Chemical</b>	<b>Computational Modeling of Human Behavior</b>
<b>Armament and Survivability, Armaments and Energetics</b>	<b>Cognitive Neuroscience</b>
<b>Directed Energy, Directed Energy</b>	<b>Other</b>

## **COMMAND, CONTROL, COMMUNICATION, AND COMPUTER (C4)**

Within the U.S. Government, C4 is ubiquitous. The hardware that comprises C4 is the backbone of almost all government function from battlefield commanders to interagency communications. Monitors, computers, printers, phones, radios, and data links are all necessary in this network-centric environment.

Technology in this category includes, but is not limited to the following:

- Common data links
- Monitors
- Printers
- Telecommunication devices (phones, cell phones, radios, radio mounts)
- Commercial off-the-shelf equipment used for C4
- Antenna
- Beyond Line-of-Sight command and control (C2)
- Line of Sight C2

## **SOFTWARE**

Developers of the legacy MCTL included software in the Information Systems category. Although software is necessary for the function of information systems, there are many programs unique to industry and the private sector – not to mention critical government functions. For these reasons the addition of the software category is warranted.

Technology in this category includes, but is not limited to the following:

- Computer Aided Design (CAD) software
- Modeling and Simulation software
- Artificial Intelligence
- Swarm
- Microelectronic design software
- System Development Kits (SDK)
- Software algorithms
- Correlation software
- Databases
- Computer languages (C, C++, Objective C, Java, C#)
- Operating Systems (Mac OS, Windows, Linux)
- Finance and accounting software

## **RADARS**

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Radar is a term derived from the U.S. Navy acronym radio Detection And Ranging. Using radio waves and microwaves, radars can detect objects and determine range, altitude, direction, or speed. Technology in this category is specific to the transmission and reception of radio waves and microwaves. Other Detection and Ranging (–DAR) technology is not included in this category. Information related to signal processing capabilities is included in this section. However, information related to signal processing software is categorized in the Software category.

Technology in this category includes, but is not limited to the following:

- Mechanically steered radars
- Electronically steered radars
- Phase adaptive radars
- Pulse radars
- Continuous wave radars

## **LASERS**

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A laser is a device that emits focused, amplified light due to the stimulated emission of photons. The term laser is an acronym originating from the phrase Light Amplification by Stimulated Emission of Radiation. Two critical components to lasers – energy systems and optics – are organized in other categories.

Technology in this category includes, but is not limited to the following:

- Gas lasers
- Solid State lasers
- Chemical lasers
- Excimer lasers
- Fiber lasers
- Photonic crystal lasers
- Semiconductor lasers
- Dye lasers
- Free electron lasers
- Bio laser

## **OPTICS**

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Optics is a branch of physics studying the behavior of light and its interactions with matter and the development of equipment to detect light. Although other portions of the electromagnetic (EM) spectrum exhibit similar refractive, reflective, and diffractive properties of light, the optics categories refers to the study and detection of light in the visible, ultraviolet, and infrared portions of the EM spectrum.

Technology in this category includes, but is not limited to the following:

- Optics
- Fiber optics
- Polarization
- Reflective coatings
- Refractive coatings
- Lenses

## **SENSORS (ACOUSTIC)**

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Acoustic sensors are instruments that study and detect mechanical waves in gases, liquids, and solids. This category focuses on sound navigation and ranging in the very low and extremely high acoustic frequencies.

Technology in this category includes, but is not limited to the following:

- Active Sonar
- Passive Sonar
- Sonobouys
- Commercial off-the-shelf equipment used for sonar

## **GROUND SYSTEMS**

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Ground systems include combat and non-combat vehicle designs and capabilities. This includes the engines and transmissions used to maneuver ground systems. This category does not include armament, survivability, C4, and ISR technologies that may be added to ground system for a specific combat or non-combat role.

Technology in this category includes, but is not limited to the following:

- Light armored vehicles & designs
- Medium tactical vehicles & designs
- M1 Abrams variations of heavy tanks & designs
- Transport vehicles & designs
- Wheeled or tracked vehicles
- Unmanned ground systems

## **AERONAUTIC SYSTEMS**

Aeronautic systems include combat and non-combat air vehicle designs and capabilities. This category does not include armament, survivability, C4, and ISR technologies that may be added to aeronautic systems for a specific combat or non-combat role.

Technology in this category includes, but is not limited to the following:

- Aircraft design
- UAV (air vehicle specific) design

## **MARINE SYSTEMS**

Marine systems include combat and non-combat marine vessel designs and capabilities. This category does not include armament, survivability, C4, and ISR technologies that may be added to Marine systems for a specific combat or non-combat role. Ground vehicles that can traverse bodies of water are not included in this category.

Technology in this category includes, but is not limited to the following:

- Marine vessel design
- Unmanned marine systems

## **SPACE SYSTEMS**

Space systems include combat and non-combat space-based platform designs and capabilities. This category does not include armament, survivability, C4, and ISR technologies that may be added to space systems for a specific combat or non-combat role.

Technology in this category includes, but is not limited to the following:

- Satellite design
- Manned space systems
- Unmanned space systems

## NUCLEAR

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This category refers to information or technology related to using atomic nucleuses to produce energy or weapons. Also included in this category are nuclear storage, nuclear detection, and nuclear protection technologies – minus radiation-hardened electronics.

Technology in this category includes, but is not limited to the following:

- Nuclear reactor design/capabilities
- Nuclear weapon design/capabilities
- Nuclear weapon destruction and demilitarization technology
- Protective clothing
- Radiation detection devices (Geiger Counter)
- Radioactive material storage
- Nuclear disaster response operating procedures

## BIOLOGICAL

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This category refers to information or technology related to the use of biological (organic) agents for research and engineering – minus synthetic biology. Also included in this category are biological storage, biological agent detection, and biological agent protection technologies.

Technology in this category includes, but is not limited to the following:

- DNA research (minus analysis software)
- RNA research (minus analysis software)
- Biological or physiological research
- Biological weapons research and design
- Biological weapons destruction and demilitarization technology
- Biological agent detection equipment
- Biological disaster response operating procedures

## CHEMICAL

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This category refers to information or technology related to chemical research and engineering (chemistry). Also included in this category are chemical storage, chemical agent detection, and chemical agent protection technologies.

Technology in this category includes, but is not limited to the following:

- Chemical weapons research and design
- Chemical weapons destruction and demilitarization technology
- Chemical agent detection equipment
- Chemical disaster response operating procedures

## **ARMAMENT AND SURVIVABILITY**

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Armaments are conventional munitions technologies designed to increase the lethality of ground, aeronautic, marine, and space systems. Conversely, survivability technologies provide various levels of protection for ground, aeronautic, marine, and space systems from armaments. The technology included in this category is abundant.

Technology in this category includes, but is not limited to the following:

- Conventional small arms (5.56mm to .50 cal)
- Rockets (endo- and exoatmospheric)
- Missiles
- Armor
- Vehicle designs that provide increased survivability against improvised explosive devices
- Body armor
- Automatic and semi-automatic weapons
- Artillery rounds (90mm to 150mm)
- Mortar rounds (60mm to 120mm)
- Electromagnetic rail guns
- Hypervelocity weapons

## **DIRECTED ENERGY**

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Directed energy is the use of various forms of energy transferred from a system or weapon to a target to produce a lethal or non-lethal effect. Although a laser is considered directed energy, laser information and technology falls in a separate Laser category.

Technology in this category includes, but is not limited to the following:

- Directed electromagnetic radiation (not lasers)
- Directed particles with mass
- Directed sound

## **ENERGY SYSTEMS**

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Energy systems provide power to use or propel equipment. Simply put, energy system technologies are engines, generators, and batteries.

Technology in this category includes, but is not limited to the following:

- Gas turbine engines
- Generators
- Combustion engines
- Turbo fan engines
- Catapults
- Batteries (all size and chemical compositions)

## ***ELECTRONICS***

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Electronics is the study and engineering of electrical circuits and components. Electronics are the building blocks for almost all technologies, and each system may contain hundreds if not thousands of electronics performing a specific function to ensure the operation of a system.

Technology in this category includes, but is not limited to the following:

- Integrated circuits
- Application specific integrated circuits
- Radiation-hardened integrated circuits
- Field programmable gate arrays
- Programmable memory
- Optical filters
- Micro-sensors
- Vacuum tubes
- Capacitors
- Microprocessors
- Microcontrollers
- Digital signal processors
- Diodes
- Wafers (any molecular composition)
- Circuit boards
- Flexible circuit boards

## ***MANUFACTURING EQUIPMENT AND MANUFACTURING PROCESSES***

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This category contains manufacturing equipment that machines, cuts, folds, shapes, or prints elements and materials to a technology design or engineered specifications. In addition, different machines serving different purposes may be organized in a manner to add efficacy to a manufacturing process.

Technology in this category includes, but is not limited to the following:

- 3D printers
- Computer Numerical Control (CNC) machines (except the machine software)
- Lathes
- Die press lines
- Robot work cells



## ***POSITIONING, NAVIGATION, AND TIME***

Positioning is the ability of a technology or person to accurately and precisely determine one's location and orientation two dimensionally (or three dimensionally when required) referenced to a standard geodetic system (such as World Geodetic System 1984, or WGS84). Navigation is the ability to determine current and desired position (relative or absolute) and apply corrections to course, orientation, and speed to attain a desired position anywhere around the world, from sub-surface to surface and from surface to space; and timing is the ability to acquire and maintain accurate and precise time from a standard (Coordinated Universal Time, or UTC), anywhere in the world and within user-defined timeliness parameters. Timing includes time transfer.

Technology in this category includes, but is not limited to the following:

- Gyroscopes
- Global Positioning Systems (minus electronics, user software, and simulation software)
- Atomic clocks
- Accelerometers

## ***SIGNATURE CONTROL***

Signature control technologies reduce or eliminate visual, signal, and auditory signs of other technologies or systems. Stealth is the common term used to describe technology in this category.

Technology in this category includes, but is not limited to the following:

- Compounds or materials engineered to reduce or eliminate a signature
- The chemical composition of signature control compounds
- The processes used to apply signature control compounds and materials
- Capabilities and limitations of signature control material and compounds

## ***MATERIALS: RAW & PROCESSED***

Raw material is the basic material from which a product is manufactured or made. For example, uranium ore is a raw material; however, enriched uranium is not.

Technology in this category includes, but is not limited to the following:

- Any ore
- Crude oil
- Rare earth minerals

## **AGRICULTURAL**

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Technology in this category is primarily used in the operation of an agricultural area or farm.

Technology in this category includes, but is not limited to the following:

- Soil cultivation machinery
- Planting machinery
- Irrigation technology
- Produce sorters
- Harvesting technology

## **MEDICAL**

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This category includes a broad area of technology used to research, diagnose, and treat disease, medical, and genetic conditions affecting humans.

Technology in this category includes, but is not limited to the following:

- Electron microscopes
- Sonograms
- Magnetic Resonance Imaging Machines
- X-radiation machines
- Medicine distribution technology
- Disease and vector research

## ***EMERGING TECHNOLOGY***

The following technology categories are emerging. Many of the concepts and definitions are theoretical; however, the U.S. Government and private industry are investing in research in these areas. Since there is limited application of these theories, a list of technologies included in these categories will not be listed in this document. When a practical commercial or military application of the technology is developed the category will move out of the emerging section.

## ***NANOTECHNOLOGY***

Nanotechnology is the study and science of manipulating matter at the atomic or slightly larger molecular level. Nanotechnology has future application in a broad list of professions and industries: medicine, biology, electronics (including semiconductor physics), energy, etc. Most applications in this area are emerging; however, any technology engineered to function at a molecular scale is considered nanotechnology. Functions can be as simple as giving electrons a defined, less resistant path to travel.

## ***SYNTHETIC BIOLOGY***

Synthetic biology merges life science (biology) and physical science (engineering) to design and construct new biological parts, devices, and systems and the redesign of existing, natural biological systems for useful purposes.

## ***ENERGETIC MATERIALS***

Energetic materials are a group of materials that have a high amount of stored chemical energy. Research in this category focuses on metamaterials and plasmonics.

## ***QUANTUM SYSTEMS***

Quantum systems are engineered to predict the quantum states atomic and subatomic particles. Physicist and engineers using quantum mechanics are conducting research in areas of quantum cryptography, quantum computing, and quantum teleportation.

## ***COMPUTATIONAL MODELING OF HUMAN BEHAVIOR***

Computational modeling of human behavior is the research and study of individual decisionmaking. In theory, known experience, social networks, genetics, and environmental stimuli can be modeled to predict an individual or groups behavior.

## ***COGNITIVE NEUROSCIENCE***

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Cognitive neuroscience is an academic field of research merging psychology and neuroscience. The goal of this research is to understand the fundamental aspects of human behavior and thought by investigating the psychological, computational, and neuroscientific bases of cognition.

## ***OTHER***

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Technology not otherwise categorized.