

Technology

Tools are used to adapt, change, or control an environment. Tool-using cultures are groups of beings (not necessarily sophonts) with the ability to find or make tools. But, using tools is not enough:

Technology is the ability to use tools to make other tools.

When societies make the leap to using tools to make tools, they become technological. Technology builds on the successes of earlier tool-making experiences, and progresses to ever higher levels.

Many beings (not necessarily sophonts) make and use tools. Technological cultures make the leap to intelligence when they discover how to use tools to make other, more sophisticated, tools.

UNDERSTANDING TECHNOLOGY

Technology's value is three-fold:

A person using technology can do more (often much more) than a similar person not using technology. **Technology is a labor multiplier.**

A person using technology can achieve higher quality (often much higher) than a similar person not using technology. **Technology enhances quality.**

A person using technology can create objects or results which are impossible without the use of technology. **Technology can achieve impossibilities.**

Defining Tools

Tools are defined very broadly. They are the objects by which sophonts manipulate the universe.

A hammer is a tool for construction. A communicator is a tool for information exchange. A hazmat suit is a tool for safely handling hazardous materials.

Tools and Tools². Because technology is the use of tools to make tools, a special term is required: tools² (in place of the longer and more tedious term tool-making tools.)

Tools Shape Us. A technological society is shaped by the tools it makes and uses. A society with efficient biological tools becomes focused on biological structures and concentrates its research and output on biological machines.

DESCRIBING TECHNOLOGY

Technology is classified by Technological Level (or Tech Level, or TL): each TL represents a significant increase in the capabilities of the previous TL.

Powers of 10. Each TL represents a combined order of magnitude increase in capability (measured across the three measures of technology: labor enhancement, quality improvement, and achievement of impossibilities).

Technological Levels. Technological Levels are numbered on a theoretically open ended scale beginning with Zero and extending through 15 and higher. At much higher levels, technology becomes incomprehensible to much lower levels.

For example,

The Tech Level for an object is often appended to an object name. Rifle-5 is a tech level 5 firearm. Comm-10 is a tech level 10 communicator.

Tech Level is often used to describe a world or a society. Regina (the world) is TL-10. The Aslan Colonies which span the Great Rift are TL-12.

There Are Alternatives To Technology

There are non-technological activities which can achieve the results of technology. Social groups with poor access to tools (abyssal societies with limited access to fire; hydrogen societies with limited access to solid objects; those with clumsy manipulators; swimmers and aquatic cultures) may develop alternative or non-technological cultures.

Cultures. Some societies use Culture (the norms of behavior for a society) as a substitute for technology. A culture that expects higher labor output per individual, or greater attention to quality, or even spontaneous response to challenges is substituting cultural imperatives for technology.

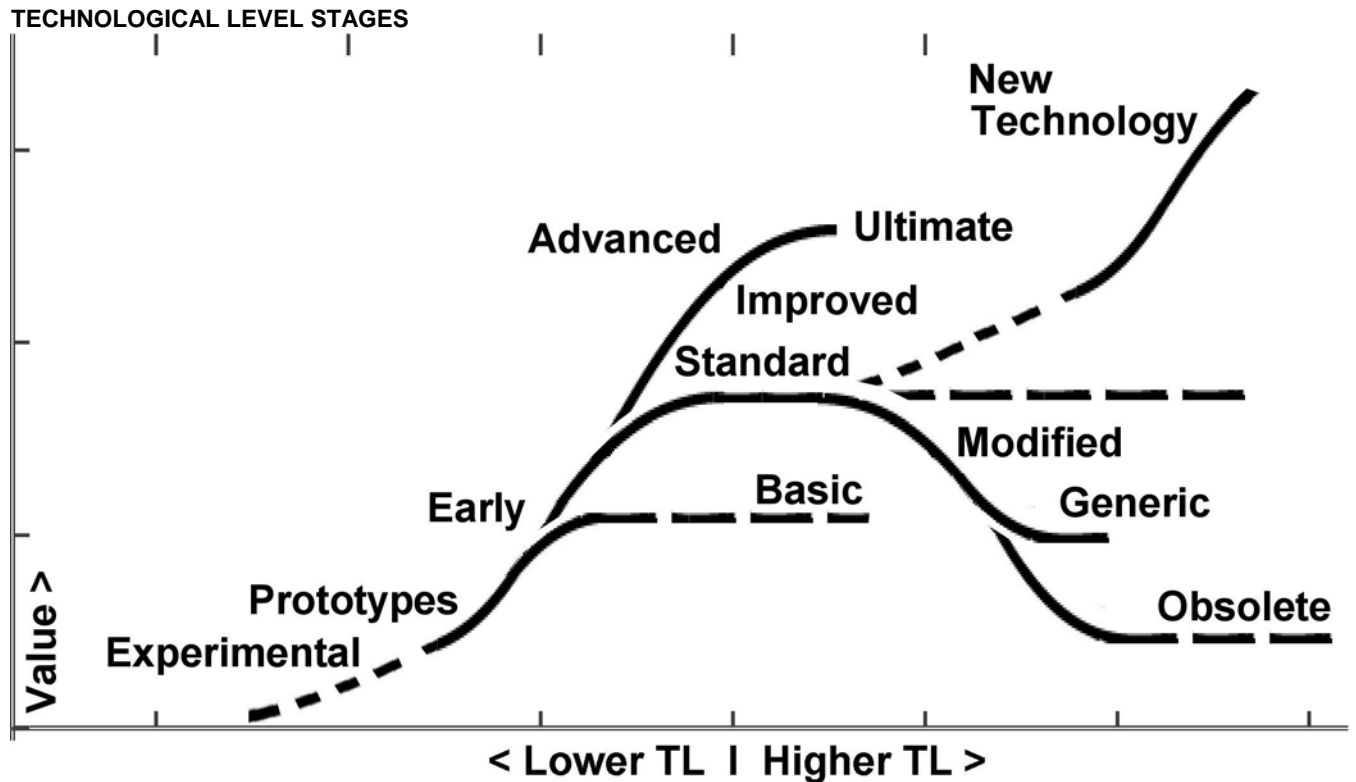
Disciplines. Some individuals adopt disciplines which increase their efficiency or improve their output quality. Members of a martial arts discipline are more effective (efficient) because of their devotion to its principles.

Geneering. Some species develop the ability to alter their own genetics. These altered individuals become tool-substitutes. The **Pseudo-Technological Hypothesis** remains unsettled: If a geneering culture creates a being (a tool) which can then create other and different geneered beings (other tools), does that meet the definition of technology?

Parasitism or Symbiosis. Some sophonts are themselves unable to use tools: they attach themselves to hosts (sophont tool users). The parasites themselves are not tool users, but may achieve the benefits of technology through their hosts.

Nevertheless

The vast majority of sophont cultures throughout the universe (90% of sophont cultures; 99% of sophont cultures reaching beyond their own homeworld) are technological.



Tech Level Stages

A Tech Level shows devices that an industry with available tools can manufacture, maintain, and use. Tech Levels are an inexact approximation: they shade into earlier and later TLs. Such gradations are expressed as Stages. Tech Level Stages describe locations in the long term cycle of technological development. For example,

Experimental is handmade by inventors excited about the potential of a new technology, usually one-of-a-kind, and often dangerous and unreliable.

Prototype is the first step before early mass production. There are perhaps a dozen examples of any one prototype.

Early is the first mass-produced design, before the technology has been completely refined.

Basic is a cheaper, bulkier, less-featured version of the standard item.

Standard is the version with the expected features for the technology when it is mature and stable.

Alternate is a rethinking of the application of technology, often emphasizing different results or outputs.

Improved is the implementation of additional features.

Modified is a specialized version created in response to specific needs..

Generic is an equivalent to the standard version produced at lower cost using higher tech level manufacturing capabilities.

Advanced has significant capabilities added.

Ultimate implements significant improvements learned over the life cycle of the product. Beyond Ultimate is new technology.

UNDERSTANDING TL STAGES

Analyze a common type of device (a car, a rifle, an entertainment system, a communicator) by assigning it TL Stages and visualize precisely what each Stage means.

Stage	Device	Device
Experimental	Car	Rifle
Prototype	Car	Rifle
Early	Car	Rifle
Basic	Car	Rifle
Standard	Car	Rifle
Alternate	Car	Rifle
Improved	Car	Rifle
Modified	Car	Rifle
Generic	Car	Rifle
Advanced	Car	Rifle
Ultimate	Car	Rifle

TECH LEVEL STAGE EFFECTS

TL	Stage	Q	R	E	B	S	Comments
-2	Experimental	F	-2	-3	+3	-3	One of a kind. Lesser capabilities. Much heavier. Very costly.
-1	Prototype	F	-2	-2	+2	-2	One of very few. Lesser capabilities. Heavier. Costly.
-1	Early	F		-1	+1	-1	Lesser capabilities. Heavy. Costly.
0	Standard	F					Typical of available models.
0	Basic	F			+1		Heavier. Cheaper.
+1	Alternate	F					Some different capabilities.
+1	Improved	F	+2	+2			Some improved capabilities. Greater Ease of Use.
+2	Modified	F		+1		+1	Lighter.
+2	Generic	F					Functionally equivalent to Standard, but cheaper.
+3	Advanced	F	+2	+2	-2	+2	Lighter. Added capabilities.
+4	Ultimate	F	+2	+3	-2	+3	Lighter. Most effective. Costlier.

F= Flux (the value may vary depending on the manufacturer).

DECIMAL TECH LEVELS

Any Tech Level can be subdivided into decimal sublevels to highlight or rank differences.

Historical Differences. Decimal Tech Levels allows a greater understanding of the historical relationships between devices. Tech Level 1 is filled with inventions and decimal levels help rank them.

Situational Differences. Objects within a TL may differ in their sophistication. Detailed comparisons of objects at a specific TL may call for decimal levels. Some Stages of objects represent differences of less than a full TL and decimal levels may be appropriate.

LEAPS IN TECHNOLOGY

The steady increase in Technological Levels is punctuated by occasional Leaps: major advances that introduce new concepts. The effects of such leaps are felt for many levels to follow.

TL-1. Using Tools To Make Tools. By far, the greatest technological leap is the first one: the increase from TL-0 to TL-1. The culture, which already uses simple tools (rocks; clubs) discovers the ability to use them to make other, more sophisticated tools.

TL-4. Division of Labor and Mass Production. The invention (or the discovery) of division of labor and mass production marks the transition from individual craftsmen to relatively unskilled labor. Objects show a significant increase in labor efficiency and an increase in quality.

TL-7. Processors. The widespread availability of information processors and integrated electronic circuits makes possible sophisticated devices which supplant tedious sophont thought processes.

TL-10. Gravity Manipulation. The development of practical gravity manipulation and its associated transportation systems revolutionize travel and the movement of goods.

TL-13. Effective Biological Sciences. Cloning, supplemented by forced-growth processes, makes geneering possible.

TL-16. Artificial Persons. The widespread availability of artificial persons, including practical robots, artificial intelligence in computers, and self-aware mechanisms replaces sophonts in most non-creative activities.

TL-19. Matter Transport. The availability of elemental matter portals (transporting raw materials across Au distances efficiently) transforms concepts of physical value.

TL-22. Individual Transformations. The lines between individuals blur as bodies become customizable, replaceable, and disposable.

TL-25. Psionic Engineering. Technological tools based on psionic principles revolutionize communications and manufacturing.

TL-28. Stellar Scale Physical Manipulation. Technology develops capabilities to manipulate worlds and stars.

TL-31. Pocket Universes. The ability to create and manipulate pocket universes infinitely expands available resources and turns all but the most adventurous inward. Includes reality manipulation.

TL-33. The Technological Singularity.

AN INEXACT PROGRESSION

The Technological Scale ranks technology; it does not define how far a society will go, or how fast it will progress.

Technological progress is often (as here) presented as a linear sequence: a steady progression from TL-5 to TL-6 to TL-7.

The reality is far more complex:

Societies Are Contaminated By Other Technologies.

Unless a society develops in true isolation, it absorbs other technologies as it encounters them. There is no **Prime Directive**: no external rules that protects developing technologies from interference. Individuals and companies are free to sell technology to any markets that will buy it.

The result is that societies have a wide range of available technologies: imported devices, local adaptations, crude imitations, and even local alternatives. Once a society knows something is possible (because a visiting star captain had a working device), it can attempt to duplicate it.

Not All Technological Societies Advance

Technology does not mandate advancement. Societies may adopt enough technology to meet their needs and then be content with stability.

A culture which values reproduction (at a non-conscious, genetic level) may discover technological means of enhancing reproduction, leading to overpopulation leading to societal and technological collapse.

A pleasure-seeking culture may advance in some areas but ignore technology which does not advance its pursuit of hedonism.

Some cultures value social stability: technology that disrupts society may be banned or suppressed.

Not All Technological Societies Survive

Technology does not mandate survival. A society may face challenges which overwhelm its tech level. Or technology may itself destroy a society.

Plague or disaster can wipe out a society whose Technological level is insufficiently advanced.

A violent culture may discover nuclear weapons and destroy itself (or follow cycles of development and regression).

An irresponsible culture may adopt nuclear power without sufficient safeguards, or genetic modifications or industrialization without considering the long-range consequences.

Not All Technological Societies Prosper

Technology does not guarantee prosperity or quality of life. An oppressive society may depend on technology to maintain its domination of the population.

A culture may concentrate its technology (for reasons incomprehensible outside of that culture) in areas other than the general welfare: in strange or useless or peripheral activities that do not improve or advance society in general.

THE PARADIGM SHIFTS

There are a very few significant technological advancements that most societies never discover. These **paradigm shifts** are concepts that require such a profound change in basic understandings of principles that they are discovered only phenomenal genius, or phenomenal luck.

The total number of possible paradigm shifts is unknown but probably very small. Three known examples are:

Jump Drive. Jump Drive technology enables a ship to transition into Jump Space and emerge some great distance away within a reasonable time, effectively multiples of 170 times the speed of light.

Jump drive makes interstellar flight practical.

Fusion Plus. Fusion Plus (or cold fusion or Fusion+ or F+) produces an efficient (very little waste heat) energy output through catalyzed fusion of hydrogen.

Cold fusion disconnects ordinary activity from the cost of energy.

Cold fusion is distinguished from Fusion by its small size: Fusion is suitable for large multi-kiloton installations; Fusion Plus is a small, relatively portable installation suitable for vehicles and homes.

Reality Manipulation. Reality engineering allows editing of reality on a real-time basis: manipulation of physical laws, and revision or reversal of event flow.

The Favored Society Effect. A very few (one in a thousand) societies independently make a paradigm shift at the proper time to discover one of the crucial technological advances. These favored, fortunate societies gain in two ways: they have an important technological principle that gives them power over their less fortunate neighbors, and the discovery imparts to their collective self-image a level of confidence or self-esteem that makes them to a dominant position in interstellar society.

For example, the discovery of Jump Drive by the Vilani (at a time when all of its neighbors were using NAFAL Not-As-Fast-As-Light drives) gave them a technological advantage and reinforced their own self-image as the natural rulers of interstellar space. They used their discovery to found an empire that lasted five thousand years.

The Favored Society Effect Inverse. Many societies send out expeditions to the stars and find the universe is already settled. Some societies are visited by starfarers bringing new technology and the implied message that the stars are home to better, stronger, superior cultures. Most such societies retreat to their own territories, content to rule their homeworld and focus inward.

When the Kisthdra first ventured beyond their system in NAFAL ships, the crews returned home aboard Vilani starliners. The realization that the stars had already been conquered, and belonged to someone else, crushed the collective spirit of Kisthdra society: they rarely venture beyond their world even now.

The result is interstellar domination by a favored few sophonts, and many worlds each home to a unique race and its own introspective interests.

THE TECHNOLOGICAL SINGULARITY

Technology builds on technology. Each Tech Level is built on the previous ones.

Technological knowledge increases exponentially. Each Tech Level represents an expanding body of knowledge: many of the advances increase the rate at which new advances can be made.

Technological progress accelerates. The time between technological levels decreases, assuming a large population working on technology sufficient resources being devoted to it, and assuming the cultures involved care about advancing technology.

There Is A Maximum

Ultimately, the tool-making tools of technology surpass the capabilities of the sophonts who use them. Computers may surpass sophonts in intelligence, and more importantly, in sophont-like insights. Computer interfaces may raise the abilities of sophonts to new levels. Geneering and medical science may increase the intelligence and talents of sophonts to a degree that accelerates technological advance.

TL-Z = The Technological Singularity= TL-33

The Technological Singularity. There is an endpoint in the TL scale where tools become self-replicating, self-improving, and panscient (all skillful). With these features in place, technology becomes meaningless and is no longer an applicable term.

At the Technological Singularity, everything is possible: tools² respond to virtually all needs without discernible delay.

For example, as a society advances beyond TL-24 and approaches TL-Z, technology provides everything, in high quality, on demand, to everyone in the society. Robots or sophontoids do all the work; artificial intelligences manage all of society's systems; individuals can choose any number of entertainments or challenges, learn or access most of the knowledge of the universe, do anything, experience anything, do anything, and all without risk, and strangely enough, without challenge of reward. At that point, sophonts must either grow, or die. Various societies choose various options, but in every circumstance:

The Technological Singularity is Unstable. The features and the abilities of the Technological Singularity promote any number of consequences, all of which lead to changes that end the Technological Singularity.

Some consequences are:

; Society transcends technology advancing to metaphysical pursuits which transcend the physical plane.

; Society retreats to a simple, non-technological pastoral existence.

; Society collapses from the strain. It loses its high tech tools and begins the cycle of technological development again.

; Society fragments; some factions transcend; others retreat; still others struggle to maintain or reacquire the TS.

The Single Example of a Technological Singularity

History recognizes one period in which the Technological Singularity was approached (if not actually achieved).

Insert your guess here. _____.