

The 39 Parameters of TRIZ

Contradiction and trade-off

A common characteristic of problem solving is that in trying to improve one desirable parameter or property, another desirable property degrades. This characteristic of problem solving can be viewed as a trade-off or contradiction. Examples of contradictions in tackling a problem can be observed in the following examples.

- Bin design. A large bin is desirable so that it does need to be emptied often but a small is desirable so that it does not occupy too much space.
- The forming of a horseshoe. A horseshoe needs to be hot so that it is easier to alter the shape of the material but it is also desirable for the shoe to be cold so that it is easy to handle.
- Axe design. If you make the blade heavier it can strike a more effective blow with better splitting power, but it becomes more awkward to handle.

Conventional problem solving generally leads to a 'compromise' solution. Altshuller noted that the most 'inventive' solution is obtained when a technical problem containing a 'contradiction' is solved by completely eliminating the contradiction.

From the initial research, Altshuller found that there were only 39 generic parameters which either improve or degrade. Examples of these parameters include items such as the weight of a moving object, speed, force, temperature, accuracy of measurement and ease of repair. In the development of the list of generic parameters, specific meaning was given to a moving and stationary object. Objects which can easily change position in space, either on their own or as a result of external forces, are classed as moving objects. Objects or vehicles that are designed to be portable are the basic members of this class. Objects which do not change position in space, either on their own or as a result of external forces, are classed as stationary objects.

The 39 generic parameters and a brief explanation are given in the table below:

No	TITLE	EXPLANATION
1	Weight of moving object	The mass of the object in a gravitational field. The force that the body exerts on its support or suspension.

2	Weight of stationary object	The mass of the object in a gravitational field. The force that the body exerts on its support or suspension, or on the surface on which it rests.
3	Length of moving object	Any one linear dimension, not necessarily the longest, is considered a length.
4	Length of stationary object	Any one linear dimension, not necessarily the longest, is considered a length.
5	Area of moving object	A geometrical characteristic described by the part of a plane enclosed by a line. The part of a surface occupied by the object, OR the square measure of the surface, either internal or external, of an object.
6	Area of stationary object	A geometrical characteristic described by the part of a plane enclosed by a line. The part of a surface occupied by the object, OR the square measure of the surface, either internal or external, of an object.
7	Volume of moving object	The cubic measure of space occupied by the object. Length x width x height for a rectangular object, height x area for a cylinder, etc.
8	Volume of stationary object	The cubic measure of space occupied by the object. Length x width x height for a rectangular object, height x area for a cylinder, etc.
9	Speed	The velocity of an object; the rate of a process or action in time.
10	Force	Force measures the interaction between systems. In Newtonian physics, force = mass x acceleration. In TRIZ, force is any interaction that is intended to change an object's condition.
11	Stress or pressure	Force per unit area. Also, tension.
12	Shape	The external contours ; appearance of a system.
13	Stability of the object's composition	The wholeness or integrity of the system; the relationship of the system's constituent elements. Wear, chemical decomposition, and disassembly are all decreases in stability. Increasing entropy is decreasing stability.
14	Strength	The extent to which the object is able to resist changing in response to force. Resistance to breaking.
15	Duration of action by a moving object	The time that the object can perform the action. Service life. Mean time between failures is a measure of the duration of action. Also, durability.
16	Duration of action by a stationary object	The time that the object can perform the action. Service life. Mean time between failures is a measure of the duration of action. Also, durability.
17	Temperature	The thermal condition of the object or system. Loosely includes other thermal parameters, such as heat capacity, that affect the rate of change of temperature.
18	Illumination	Light flux per unit area, also any other illumination

	intensity	characteristics of the system such as brightness, light quality, etc.
19	Use of energy by moving object	The measure of the object's capacity for doing work. In classical mechanics, Energy is the product of force x distance. This includes the use of energy provided by the super-system (such as electrical energy or heat.) Energy required doing a particular job.
20	Use of energy by stationary object	The measure of the object's capacity for doing work. In classical mechanics, Energy is the product of force x distance. This includes the use of energy provided by the super-system (such as electrical energy or heat.) Energy required doing a particular job.
21	Power	The time rate at which work is performed. The rate of use of energy.
22	Loss of Energy	Use of energy that does not contribute to the job being done. See 19. Reducing the loss of energy sometimes requires different techniques from improving the use of energy, which is why this is a separate category.
23	Loss of substance	Partial or complete, permanent or temporary, loss of some of a system's materials, substances, parts, or subsystems.
24	Loss of Information	Partial or complete, permanent or temporary, loss of data or access to data in or by a system. Frequently includes sensory data such as aroma, texture, sound.
25	Loss of Time	Time represents the duration of an activity. Improving the loss of time means reducing the time taken for the activity. "Cycle time reduction" is a common requirement.
26	Quantity of substance/the matter	The number or amount of a system's materials, substances, parts or subsystems which might be changed fully or partially, permanently or temporarily.
27	Reliability	A system's ability to perform its intended functions in predictable ways and conditions.
28	Measurement accuracy	The closeness of the measured value to the actual value of a property of a system. Reducing the error in a measurement increases the accuracy of the measurement.
29	Manufacturing precision	The extent to which the actual characteristics of the system or object match the specified or required characteristics.
30	External harm affects the object	Susceptibility of a system to externally generated (harmful) effects.
31	Object-generated harmful factors	A harmful effect is one that reduces the efficiency or quality of the functioning of the object or system. These harmful effects are generated by the object or system, as part of its operation.
32	Ease of manufacture	The degree of facility, comfort or effortlessness in manufacturing or fabricating the object/system.
33	Ease of operation	Simplicity: A process is not easy if it requires a large number of people, large number of steps in the operation, needs

		special tools, etc. "Hard" processes have low yield and "easy" processes have high yield; they are easy to do right.
34	Ease of repair	Quality characteristics such as convenience, comfort, simplicity, and time to repair faults, failures, or defects in a system.
35	Adaptability or versatility	The extent to which a system/object positively responds to external changes. Also, a system that can be used in multiple ways in a variety of circumstances.
36	Device complexity	The number and diversity of elements and element interrelationships within a system. The user may be an element of the system that increases the complexity. The difficulty of mastering the system is a measure of its complexity.
37	Difficulty of detecting and measuring	Measuring or monitoring systems that are complex, costly, require much time and labour to set up and use, or that have complex relationships between components or components that interfere with each other all demonstrate "difficulty of detecting and measuring." Increasing cost of measuring to a satisfactory error is also a sign of increased difficulty of measuring.
38	Extent of automation	The extent to which a system or object performs its functions without human interface. The lowest level of automation is the use of a manually operated tool. For intermediate levels, humans program the tool, observe its operation, and interrupt or re-program as needed. For the highest level, the machine senses the operation needed, programs itself, and monitors its own operations.
39	Productivity	The number of functions or operations performed by a system per unit time. The time for a unit operation. The output per unit time, or the cost per unit output.
	Title	Explanation
	Moving objects	Objects which can easily change position in space, either on their own, or as a result of external forces. Vehicles and objects designed to be portable are the basic members of this class.
	Stationary objects	Objects which do not change position in space, either on their own, or as a result of external forces. Consider the conditions under which the object is being used.