

Using TRIZ PRINCIPLES as QUESTIONS to Inspire Innovation

“it” = people, processes, technology, places, or things

1. Segmentation (Principle #1)

1. How might it be segmented?
2. How might it be segmented into independent parts?
3. How might it be easy to disassemble?
4. How might the degree of fragmentation or segmentation be increased?

2. Separation (Principle #2)

5. How might its interfering parts or properties be singled out?
6. How might only its necessary part be singled out?

3. Local Quality (Principle #3)

7. How might its structure be changed from uniform to non-uniform?
8. How might its external environment or influence be changed from uniform to non uniform?
9. How might it or parts of it function in conditions most suitable for its operation?
10. How might it or parts of it fulfill different and useful functions?

4. Symmetry Change (Principle #4)

11. How might it be changed from symmetrical to asymmetrical?
12. If it is asymmetrical, how might the degree of asymmetry be increased or decreased?

5. Merging (Principle #5)

13. How might its identical or similar parts be brought closer together or merged?
14. How might its identical or similar parts be assembled to perform parallel operations?
15. How might its operations be contiguous or parallel?
16. How might its operations be brought together in time?

6. Multifunctionality (Principle #6)

17. How might it or its parts perform multiple functions?
18. How might it or its parts eliminate the need for other parts?

7. Nested Doll (Principle #7)

19. How might one of its parts be placed inside another?
20. How might one of its parts be placed inside another, and then inside another?
21. How might one of its parts pass through a something into another?

8. Weight Compensation (Principle #8)

22. How might its weight be compensated by merging with other objects to provide lift?
23. How might its weight be compensated by interacting with the environment?
24. How might its weight be compensated by interacting with the aerodynamic forces?
25. How might its weight be compensated by interacting with the hydrodynamic forces?
26. How might its weight be compensated by interacting with the aerodynamic buoyant forces?

9. Preliminary Counteraction (Principle #9)

27. How might actions that have both harmful and useful effects be preceded by a counter action to control the harmful effects?
28. How might beforehand stresses be created that will oppose known undesirable working stresses?

10. Preliminary Action (Principle #10)

29. How might a partial or full change be performed before it is needed or required?
30. How might it or its parts be pre-arranged so they can come into action at the most convenient place without losing delivery time?

11. Beforehand Compensation (Principle #11)

31. How might emergency means be prepared beforehand to compensate for relatively low reliability?

12. Equipotentiality (Principle #12)

32. How might limits be changed?

13. The Other Way Round (Principle #13)

33. How might action(s) used to solve the problem be inverted? (e.g., instead of decreasing costs, increase them).
34. How might movable parts (or the external environment) be fixed, and fixed parts be movable?
35. How might it be turned 'upside down'?

14. Curvature Increase (Principle #14)

36. Instead of using rectilinear parts, surfaces, or forms, how might curvilinear ones be used, move from flat surfaces to spherical ones, from parts shaped as a cube (parallelepiped) to ball-shaped structure?
37. How might rollers, balls, spirals, and domes be used?
38. How might it go from linear to rotary motion using centrifugal forces?

15. Dynamics Parts (Principle #15)

39. How might its characteristics, external environment, or processes be made optimal?
40. How might it be divided into parts capable of movement relative to each other?
41. If it is rigid or inflexible, how might it be made movable or adaptive?

16. Partial or Excessive Actions (Principle #16)

42. If 100 percent of an effect is hard to achieve using a given solution method then, how might using slightly less or slightly more of the same method make the problem considerably easier to solve?

17. Dimensional Change (Principle #17)

43. How might it be moved in two-or-three-dimensional space?
44. How might its multi-story arrangement be used instead of a single-story arrangement?
45. How might it be tilted or re-oriented to lay it on its side?
46. How might 'another side' be used?

18. Mechanical Vibration (Principle #18)

47. How might it be caused to oscillate or vibrate?
48. How might its frequency be increased (even up to the ultrasonic level)?
49. How might its resonant frequency be used/?
50. How might piezoelectric vibrations, instead of mechanical ones, be used?
51. How might combined ultrasonic and electromagnetic field oscillations be used?

19. Periodic Action (Principle #19)

- 52. Instead of continuous action, how might periodic or pulsating actions be used?
- 53. If an action is already periodic, how might the periodic magnitude or frequency be changed?
- 54. How might pauses between impulses to perform a different action be used?

20. Continuity of Useful Action (Principle #20)

- 55. How might work be carried on continuously? How can all parts of an object be made to work at full load all the time?
- 56. How might all idle or intermittent actions or work be eliminated?

21. Hurrying (Principle #21)

- 57. How might it or certain stages or parts (e.g., destructive, harmful or hazardous operations) be conducted at high speed?

22. Blessing in Disguise (Principle #22)

- 58. How might its harmful factors (particularly, harmful effects of the environment or surroundings) be used to achieve a positive effect?
- 59. How might its primary harmful action be eliminated by adding it to another harmful action to resolve the problem?
- 60. How might its harmful factor be amplified to such a degree that it is no longer harmful?

23. Feedback (Principle #23)

- 61. How might feedback (referring back, cross-checking) be introduced to improve a process or action?
- 62. If feedback is already used, how might its magnitude or influence be changed?

24. Intermediary (Principle #24)

- 63. How might an intermediate carrier article or intermediary process be used?
- 64. How might it or its parts temporarily be merged with another (which can be easily removed)?

25. Self-Service (Principle #25)

- 65. How might it or its parts be made to serve itself by performing auxiliary helpful functions?
- 66. How might waste resources, energy, or substances be used?

26. Copying (Principle #26)

- 67. Instead of an unavailable, expensive, fragile object; how might simpler and inexpensive copies be used?
- 68. How might an object, or process, with their optical copies, be replaced?
- 69. If visible optical copies are already used, how might infrared or ultraviolet copies be used?

27. Cheap Disposables (Sometimes Short-Living) Replacement Events (Principle #27)

- 70. How might an expensive object with a multitude of inexpensive objects, compromising certain qualities (such as service life, for instance) be replaced?

28. Mechanical Interaction Substitution (Principle #28)

- 71. How might a mechanical means with a sensory (optical, acoustic, taste or smell) means be replaced?
- 72. How might electric, magnetic and electromagnetic fields to interact with it be used?
- 73. How might it be changed from a static to movable field, from unstructured fields to those having structure?
- 74. How might fields in conjunction with field-activated (e.g., ferromagnetic) particles be used?

29. Pneumatics and Hydraulics (Principle #29)

- 75. How might gas and liquid parts of an object instead of solid parts (e.g., inflatable, filled with liquid, air cushion, hydrostatic, hydro-reactive) be used?

30. Flexible Shells and Thin Films (Principle #30)

- 76. How might flexible shells and thin films instead of three dimensional structures be used?
- 77. How might it or its parts from the external environment using flexible shells and thin films be isolated?

31. Porous Materials (Principle #31)

- 78. How might it or its parts be made porous?
- 79. If it is already porous, how might the pores be used to introduce a useful substance or function?

32. Optical Property Changes (Principle #32)

- 80. How might its color, visuals, or its external environment be changed?
- 81. How might its transparency or its external environment be changed?

33. Homogeneity (Principle #33)

- 82. How might objects interacting with a given object be made of the same material (or material with identical properties)?

34. Discarding and Recovering (Principle #34)

- 83. How might it or its parts that have fulfilled their function be made to go away (discard by dissolving, evaporating, etc.) or be modified directly during operation?
- 84. Conversely, how might consumable parts be restored directly during operation?

35. Parameter Changes (Principle #35)

- 85. How might its physical state (e.g., to a gas, liquid, or solid) be changed?
- 86. How might its concentration or consistency be changed?
- 87. How might its degree of flexibility be changed?
- 88. How might its temperature be changed?

36. Phase Transitions (Principle #36)

- 89. How might the phenomena occurring during phase transitions (e.g., volume changes, loss or absorption of heat, etc.) be used?

37. Thermal Expansion (Principle #37)

- 90. How might thermal expansion (or contraction) of materials be used?
- 91. If thermal expansion is being used, how might multiple materials with different coefficients of thermal expansion be used?

38. Strong Oxidants (Principle #38)

- 92. How might the common be replaced with the enriched?
- 93. How might the enriched be replaced with the pure?
- 94. How might air or oxygen be exposed to ionizing radiation?
- 95. How might ozonized oxygen be used?
- 96. How might ozonized (ionized) oxygen be replaced with ozone?

39. Inert Atmosphere (Principle #39)

- 97. How might its normal environment be replaced with an inert one?
- 98. How might neutral parts or inert additives be added?

40. Composite Materials (Principle #40)

- 99. How might uniform materials be changed to composite (multiple) materials?