List of 40 Principles

- Principle 1. Segmentation
  - A. Divide an object into independent parts.
  - B. Make an object easy to assemble or disassemble.
  - C. Increase the degree of fragmentation or segmentation.
- Principle 2. Taking out
  - A. Separate an interfering part or property from an object, or single out the only necessary part (or property) of an object.
- Principle 3. Local quality
  - A. Change an object's structure from uniform to non-uniform
  - B. Change an external environment (or external influence) from uniform to non-uniform.
  - C. Make each part of an object function in conditions most suitable for its operation.
  - D. Make each part of an object fulfill a different and/or complementary useful function.
- Principle 4. Asymmetry
  - A. Change the shape or properties of an object from symmetrical to asymmetrical.
  - B. Change the shape of an object to suit external asymmetries (e.g. ergonomic features)
  - C. If an object is asymmetrical, increase its degree of asymmetry.
- Principle 5. Merging
  - A. Bring closer together (or merge) identical or similar objects or operations in space
  - B. Make objects or operations contiguous or parallel; bring them together in time.
- Principle 6. Universality
  - A. Make a part or object perform multiple functions; eliminate the need for other parts.
- Principle 7. "Nested doll"
  - A. Place one object inside another
  - B. Place multiple objects inside others.
  - C. Make one part pass (dynamically) through a cavity in the other.
- Principle 8. Anti-weight
  - A. To compensate for the weight of an object, merge it with other objects that provide lift.
  - B. To compensate for the weight of an object, make it interact with the environment (e.g. use aerodynamic, hydrodynamic, buoyancy and other forces).
- Principle 9. Preliminary anti-action
  - A. If it will be necessary to perform an action with both harmful and useful effects, this action should be replaced with anti-actions to control harmful effects.
  - B. Create beforehand stresses in an object that will oppose known undesirable working stresses later on.
- Principle 10. Preliminary action
  - A. Perform, before it is needed, the required change of an object (either fully or partially).
  - B. Pre-arrange objects such that they can come into action from the most convenient place without losing time for their delivery.
- Principle 11. Beforehand cushioning
  - A. Prepare emergency means beforehand to compensate for the relatively low reliability of an object (‘belt and braces’)

- Principle 12. Equipotentiality
  - A. If an object has to be raised or lowered, redesign the object's environment so the need to raise or lower is eliminated or performed by the environment
- Principle 13. 'The other way round'
  - A. Invert the action(s) used to solve the problem (e.g. instead of cooling an object, heat it).
  - B. Make movable parts (or the external environment) fixed, and fixed parts movable).
  - C. Turn the object (or process) 'upside down'.
- Principle 14. Spheroidality - Curvature
  - A. Instead of using rectilinear parts, surfaces, or forms, use curvilinear ones; move from flat surfaces to spherical ones; from parts shaped as a cube (parallelepiped) to ball-shaped structures.
  - B. Use rollers, balls, spirals, domes.
  - C. Go from linear to rotary motion (or vice versa)
  - D. Use centrifugal forces.
- Principle 15. Dynamics
  - A. Allow (or design) the characteristics of an object, external environment, or process to change to be optimal or to find an optimal operating condition.
  - B. Divide an object into parts capable of movement relative to each other.
  - C. If an object (or process) is rigid or inflexible, make it movable or adaptive.
  - D. Increase the degree of free motion
- Principle 16. Partial or excessive actions
  - A. If 100 percent of an object is hard to achieve using a given solution method then, by using 'slightly less' or 'slightly more' of the same method, the problem may be considerably easier to solve.
- Principle 17. Another dimension
  - A. If an object contains or moves in a straight line, consider use of dimensions or movement outside the line.
  - B. If an object contains or moves in a plane, consider use of dimensions or movement outside the current plane.
  - C. Use a multi-storey arrangement of objects instead of a single-storey arrangement.
  - D. Tilt or re-orient the object, lay it on its side.
  - E. Use 'another side' of a given area.
- Principle 18. Mechanical vibration
  - A. Cause an object to oscillate or vibrate.
  - B. Increase its frequency (even up to the ultrasonic).
  - C. Use an object's resonant frequency.
  - D. Use piezoelectric vibrators instead of mechanical ones.
  - E. Use combined ultrasonic and electromagnetic field oscillations.
- Principle 19. Periodic action
  - A. Instead of continuous action, use periodic or pulsating actions.
  - B. If an action is already periodic, change the periodic magnitude or frequency.
  - C. Use pauses between actions to perform a different action.
- Principle 20. Continuity of useful action
  - A. Carry on work continuously; make all parts of an object work at full load or optimum efficiency, all the time.

- B. Eliminate all idle or intermittent actions or work.

- Principle 21. Skipping
  - A. Conduct a process , or certain stages (e.g. destructible, harmful or hazardous operations) at high speed.
- Principle 22. "Blessing in disguise" or "Turn Lemons into Lemonade"
  - A. Use harmful factors (particularly, harmful effects of the environment or surroundings) to achieve a positive effect.
  - B. Eliminate the primary harmful action by adding it to another harmful action to resolve the problem.
  - C. Amplify a harmful factor to such a degree that it is no longer harmful.
- Principle 23. Feedback
  - A. Introduce feedback (referring back, cross-checking) to improve a process or action.
  - B. If feedback is already used, change its magnitude or influence in accordance with operating conditions.
- Principle 24. 'Intermediary'
  - A. Use an intermediary carrier article or intermediary process.
  - B. Merge one object temporarily with another (which can be easily removed).
- Principle 25. Self-service
  - A. Make an object serve or organise itself by performing auxiliary helpful functions
  - B. Use waste resources, energy, or substances.
- Principle 26. Copying
  - A. Instead of an unavailable, expensive, fragile object, use simpler and inexpensive copies.
  - B. Replace an object, or process with optical copies.
  - C. If visible optical copies are already used, move to infrared or ultraviolet copies.
- Principle 27. Cheap short-living objects
  - A. Replace an expensive object with a multiple of inexpensive objects, compromising certain qualities, such as service life.
- Principle 28 Mechanics substitution
  - A. Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means.
  - B. Use electric, magnetic and electromagnetic fields to interact with the object.
  - C. Change from static to movable fields, from unstructured fields to those having structure.
  - D. Use fields in conjunction with field-activated (e.g. ferromagnetic) particles.
- Principle 29. Pneumatics and hydraulics
  - A. Use gas and liquid parts of an object instead of solid parts (e.g. inflatable, filled with liquids, air cushion, hydrostatic, hydro-reactive).
- Principle 30. Flexible shells and thin films
  - A. Use flexible shells and thin films instead of three dimensional structures
  - B. Isolate the object from the external environment using flexible shells and thin films.
- Principle 31. Porous materials
  - A. Make an object porous or add porous elements (inserts, coatings, etc.).
  - B. If an object is already porous, use the pores to introduce a useful substance or function.
- Principle 32. Colour changes
  - A. Change the colour of an object or its external environment.

    - B. Change the transparency of an object or its external environment.
    - C. In order to improve observability of things that are difficult to see, use coloured additives or luminescent elements
    - D. Change the emissivity properties of an object subject to radiant heating Principle
- Principle 33. Homogeneity
    - A. Make objects interacting with a given object of the same material (or material with identical properties).
- Principle 34. Discarding and recovering
    - A. Make portions of an object that have fulfilled their functions go away (discard by dissolving, evaporating, etc.) or modify these directly during operation.
    - B. Conversely, restore consumable parts of an object directly in operation.
- Principle 35. Parameter changes
    - A. Change an object's physical state (e.g. to a gas, liquid, or solid).
    - B. Change the concentration or consistency.
    - C. Change the degree of flexibility.
    - D. Change the temperature.
    - E. Change the pressure.
    - F. Change other parameters
- Principle 36. Phase transitions
    - A. Use phenomena occurring during phase transitions (e.g. volume changes, loss or absorption of heat, etc.).
- Principle 37. Thermal expansion
    - A. Use thermal expansion (or contraction) of materials.
    - B. If thermal expansion is being used, use multiple materials with different coefficients of thermal expansion.
- Principle 38. Strong oxidants
    - A. Replace common air with oxygen-enriched air.
    - B. Replace enriched air with pure oxygen.
    - C. Expose air or oxygen to ionizing radiation.
    - D. Use ionized oxygen.
    - E. Replace ozonized (or ionized) oxygen with ozone.
- Principle 39. Inert atmosphere
    - A. Replace a normal environment with an inert one.
    - B. Add neutral parts, or inert additives to an object.
- Principle 40. Composite materials
    - A. Change from uniform to composite (multiple) materials where each material is tuned to a particular functional requirement.