

AATRIZINVENTOR SOLUTION FOR INNOVATION BASED ON NATURE'S L.I. Working Document to Build a Specific Solution.

INNOVATION CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

APPLICATION OF NATURE'S LANGUAGE OF INNOVATION / Nature's L.I.

Web site: www.aatrizinventor.com

Reference book: The Nature's Language of Innovation, José Roberto Espinoza, Amazon, Kindle.

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FACTORS OF INNOVATION:

FUNCTION AFFECTED: Extraction of termite by a chimpanzee affected by an underground termite nest

PHYSICAL VARIABLE OR CHARACTERISTIC: Less Ability to extract termites from nests underground

S1 OBJECT: CHIMPANZEE'S HAND Type: Moving

S2 OBJECT: TERMITE IN UNDERGROUND NEST Type: Stationary

DESIRED ACTION VERB: Improve

INNOVATION CHALLENGE:

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

DESIRED GOAL: More Ability to extract termites from nests underground

EVALUATED OBJECT: CHIMPANZEE'S HAND

NEED TO SATISFY > 19. Use of energy by moving object

SELECTED INNOVATION PARAMETERS TO EVALUATE:

A. UNDESIRABLE EFFECTS CAUSES OF DISSATISFACTION (UDEs)

There are More difficulty to Improve Extraction of termite by a chimpanzee affected by an underground termite nest because:

CHIMPANZEE'S HAND Has Less Own length or relative distance, whether physical or figurative interacting with S2

CHIMPANZEE'S HAND Has More Own area or two-dimensional scope interacting with S2

CHIMPANZEE'S HAND Has Less Adaptability or versatility to interaction variability of S2

CHIMPANZEE'S HAND Has More Difficulty in detection and measurement interacting with S2

There are undesirable effects that cause dissatisfaction because:

There is Less Ability to extract termites from nests underground

B. DESIRED EFFECT FOR NEED TO SATISFY

There is More ease to Improve Extraction of termite by a chimpanzee affected by an underground termite nest because:

CHIMPANZEE'S HAND Has More Efficient energy use to interact with S2

There is desirable effect for need to satisfy because:

There is More Ability to extract termites from nests underground

Table I. RELATIONSHIP WITH UNIVERSAL TRIZ INNOVATION PARAMETERS (maximum of 7 undesirable effects)

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

This table presents the selected innovation parameters to evaluate the challenge that must be resolved for the interaction between an Object S1 and an Object S2, and no others. The choice of undesirable effects must be based on a thorough review of the current situation, identifying them based on the objective evidence present within the predefined space and time of evaluation. Fulfilling this requirement is crucial: If you do not connect the dots of the current situation properly, the algorithm will deliver a disconnected solution.

The selection of the need to satisfy should reflect the best estimation of the innovation-evolution state of the object S1 being evaluated.

Recognizing the criticality of this selection process, the Aatrizinventor algorithm provides flexibility to change parameters and conducts a sensitivity analysis in order to offer alternative solutions. These alternatives are based on different combinations of the entered parameters, also including a different need to satisfy from the one originally posed.

Parameters to evaluate(s)	It is understood as CHIMPANZEE'S HAND has:
Parámetros of undesirable effects (UDE):	Undesirable effects causes of dissatisfaction:
(-) 3. Length of moving object	Less Own length or relative distance, whether physical or figurative interacting with S2
(+) 5. Area of moving object	More Own area or two-dimensional scope interacting with S2
(-) 35. Adaptability or versatility	Less Adaptability or versatility to interaction variability of S2
(+) 37. Difficulty of detecting and measuring	More Difficulty in detection and measurement interacting with S2
Desirable parameter (DE):	Desirable Effect for Need to satisfy:
(+) 19. Use of energy by moving object	More Efficient energy use to interact with S2
TRIZ undesirables parameters for sensitivity analysis	It is understood as CHIMPANZEE'S HAND has:
(-) 12. Shape / composition / configuration	Less Appropriate shape, composition, or configuration interacting with S2
n/a	
n/a	
n/a	
n/a	

EVALUTION RESULTS TABLES

TABLE II. SPECIFIC CONTRADICTION MATRIX FOR UNDESIRABLE EFFECTS AND NEED TO SATISFY. FOR EVALUATED OBJECT: CHIMPANZEE'S HAND AND NEED TO BE SATISFIED > 19. Use of energy by moving object

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

(*) Preferred parameters: Improve 3. Length of moving object & Attenuate or preserve 35. Adaptability or versatility.

Contradictions/ E.C: Essential, Comp.:Complementary, Top 5: Up to the major fifth, noted if outside the preferred parameters.

Parameters in the first row are the same as those in the first column.

Parameter to attenuate or preserve => Parameter to improve	Var.	(-) Par.3	(+) Par.5	(-) Par.35 PREF.	(+) Par.37	(+) Par.19	Sum wt
(-) 3. Length of moving object PREF.	wt		wt.15 Compl.	wt.1 E.C.	wt.6 Compl.	wt.12 Compl.	79%
	IP(s)	0,0,0,0	15,17,4,0	14,15,1,16	35,1,26,24	8,35,24,0	
(+) 5. Area of moving object	wt	wt.11		wt.9 Compl.	wt.17	wt.18	28%
	IP(s)	14,15,18,4	0,0,0,0	15,30,0,0	2,36,26,18	19,32,0,0	
(-) 35. Adaptability or versatility	wt	wt.2 Top 5	wt.19		wt.13	wt.5 Top 5	53%
	IP(s)	35,1,29,2	35,30,29,7	0,0,0,0	1,0,0,0	19,35,29,13	
(+) 37. Difficulty of detecting and measuring	wt	wt.16	wt.14	wt.3 Compl.		wt.7	44%
	IP(s)	16,17,26,24	2,13,18,17	1,15,0,0	0,0,0,0	35,38,0,0	
(+) 19. Use of energy by moving object	wt	wt.20	wt.10	wt.4 Compl.	wt.7		38%
	IP(s)	12,28,0,0	15,19,25,0	15,17,13,16	35,38,0,0	0,0,0,0	
Sum wt		44%	28%	100%	34%	37%	

This table shows the essential contradiction (E.C.) that determines the solution strategy. Additionally, preferred parameters are established where complementary contradictions (Compl.) are found, allowing the definition of the Base Solution shown in Table III.

As a complement to the Base Solution, Table II also provides the following information that could be relevant to obtain an optimal solution:

- The algorithm identifies the top 5 contradictions from the entire Table II and highlights those that are outside the preferred parameters for further review.
- There are inventive principles present in Table II that are not part of the Recommended Solution

proposed in Table V. In the latter, the top three most relevant ones are highlighted, and the contradictions they involve are presented to evaluate whether they contribute significant aspects to the desired solution. For further details, Table VIII provides a prioritization of the inventive principles from Table II, and those not included in the Recommended Solution in Table V are marked with ***.

TABLE III. BASE SOLUTION FOR THE EVALUATED OBJECT: CHIMPANZEE'S HAND

NEED TO SATISFY > 19. Use of energy by moving object

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

Table II Selection: Essential Contradiction wt.1 y Complementary contradictions with preferred parameters (*) wt.3/wt.4/wt.6/wt.9							
Parameter to improve	Parameter to attenuate or preserve	Contradict.	Wt.n	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
(-) 3. Length of moving object	(-) 35. Adaptability or versatility	Essential	wt.1	14 Es.	15 Es.	1 Es.	16 Es.
(+) 37. Difficulty of detecting and measuring	(-) 35. Adaptability or versatility	Compl. 1	wt.3	1 Es.	15 Es.	0	0
(+) 19. Use of energy by moving object	(-) 35. Adaptability or versatility	Compl. 2	wt.4	15 Es.	17	13	16 Es.
(-) 3. Length of moving object	(+) 37. Difficulty of detecting and measuring	Compl. 3	wt.6	35	1 Es.	26	24
(+) 5. Area of moving object	(-) 35. Adaptability or versatility	Compl. 4	wt.9	15 Es.	30	0	0

Inventive Principles (IP) selected for the Base Solution

IP.14. Spheroidality - Curvature - Angle - tactical type

IP.15. Dynamics - strategic type

IP.1. Segmenting/ Integrating - strategic type

IP.16. Partial or Excessive Actions - **operative type**

IP.17. Another Dimension or Field - tactical type

IP.13. Reverse or Indirect Action - strategic type

IP.35. Transformation / Parameter Changes - strategic type

IP.26. Copying/ Replicating - strategic type

IP.24. Intermediary - tactical type

IP.30. Simple Shapes/ Ways to Interact - tactical type

Table III shows the essential contradiction, the one with the highest weight, plus the following 4 complementary contradictions in weight, which are located in the row and column of the preferred parameters selected in Table II. These contradictions are considered relevant for the solution and are described as the Base Solution in Table IX.

Keep in mind that all inventive principles selected for a solution must be evaluated according to the

specific context of the contradictions in which they participate.

Inventive principles marked with 'Es.' correspond to inventive principles that belong to the essential contradiction.

TABLE IV. CONTRADICTION MATRIX COVERAGE FOR SOLUTION AMONG NEEDS TO SATISFY FOR EVALUATED OBJECT: CHIMPANZEE'S HAND, NEED TO BE SATISFY: 19. Use of energy by moving object

Coverage is defined as the extent to which the inventive principles from Table II encompass the inventive principles from Table IV. If weighted coverage is higher, it has been observed that the obtained solution is more likely to have the lowest cost and the maximum benefit-to-cost ratio.

Parameter to improve	Parameter to preserve	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
19. Use of energy by moving object	27. Reliability	19	21 nT2	11 nT2	27 nT2
19. Use of energy by moving object	15. Duration of action of moving object	28	35	6 nT2	18
19. Use of energy by moving object	33. Ease of operation	19	35	0	0
19. Use of energy by moving object	34. Ease of change, repair or maintain	1	15	17	28
19. Use of energy by moving object	32. Ease of achieving desired outcome	28	26	30	0
19. Use of energy by moving object	19. Use of energy by moving object	0	0	0	0
19. Use of energy by moving object	39. Productivity	12 nT3	28	35	0
19. Use of energy by moving object	38. Extent of automation/ autonomy	32 nT3	2 nT3	0	0
19. Use of energy by moving object	35. Adaptability or versatility	15	17	13	16
19. Use of energy by moving object	13. Stability	19	13	17	24

Inventive Principles (IP) selected for the Solution of relevant Contradictions between Needs to Satisfy

IP.19. Time-Varying Action/ Periodic or Pulsating - strategic tpe

IP.21. Skipping/ Avoiding - tactical type

IP.11. Beforehand Cushioning - tactical type

IP.27. Cheap Short-Living Objects - strategic tpe

- IP.28. Mechanics Substitution - strategic tpe
- IP.35. Transformation / Parameter Changes - strategic tpe
- IP.6. Universality - tactical type
- IP.18. Mechanical Vibrations/ Energy Variations - tactical type

94.26 % weighted coverage of the inventive principles (IP) included in Table IV. of Contradictions between Needs to Satisfy (NS), in relation to the IP included in Table II Specific Contradiction Matrix.

The inventive principles labeled with nT2 are not found in Table II. Due to this condition, the first three contradictions in Table IV containing principles marked with nT2 are described as a Solution among Needs to Satisfy in Table IX. This solution, combined with the previously mentioned Base Solution, forms the Recommended Solution by the Aatrizinventor Algorithm, shown in Table V.

From practical experience, if Table IV contains more than 3 contradictions with inventive principles not included in Table II, then it is likely to be more challenging to construct a specific solution. In that case, it is recommended to look for an alternative combination of parameters in Table VI of sensitivity analysis. It is also an option to select another need to satisfy, which is shown in Table VII Essential Contradictions of Needs to Satisfy (NS) for the same undesirable effects already evaluated for CHIMPANZEE'S HAND.

To evaluate the recommended inventive principles here and the corresponding contradictions in which they participate, it is necessary for the Base Solution to guide an initial context for the solution, as the contradictions between Needs to Satisfy do not identify which variable of the evaluated object S1 should be operated.

Inventive principles labeled with nT3 are included in Table II, but do not participate in the Recommended Solution shown in Table V. The Innovation Team must review the contradictions where they participate, to determine if there were other specific aspects that could be significant for the solution.

Unmarked inventive principles are included in Table II Specific Contradiction Matrix and in Table V Recommended Solution.

TABLE V. RECOMMENDED SOLUTION FOR INNOVATION CHALLENGE FOR EVALUATED OBJECT CHIMPANZEE'S HAND

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

Evaluated need to satisfy in this report: **19. Use of energy by moving object**

UDEs: (-) 3. Length of moving object// (+) 5. Area of moving object// (-) 35. Adaptability or versatility// (+)

37. Difficulty of detecting and measuring

Parameter to improve	Parameter to attenuate or preserve	Contradict.	Wt.n	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
(-) 3. Length of moving object	(-) 35. Adaptability or versatility	Essential	wt.1	14 Es.	15 Es.	1 Es.	16 Es.
(+) 37. Difficulty of detecting and measuring	(-) 35. Adaptability or versatility	Compl. 1	wt.3	1 Es.	15 Es.	0	0
(+) 19. Use of energy by moving object	(-) 35. Adaptability or versatility	Compl. 2	wt.4	15 Es.	17	13	16 Es.

(-) 3. Length of moving object	(+) 37. Difficulty of detecting and measuring	Compl. 3	wt.6	35	1 Es.	26	24
(+) 5. Area of moving object	(-) 35. Adaptability or versatility	Compl. 4	wt.9	15 Es.	30	0	0
19. Use of energy by moving object	27. Reliability	NS.1	wns.1	19	21	11	27
19. Use of energy by moving object	15. Duration of action of moving object	NS.2	wns.2	28	35	6	18

Relevant inventive principles from Table II not included in Recommended Solution

Before deciding on the solution, make sure you have previously reviewed the contradictions with relevant Inventive Principles from Table II, not included in the Recommended Solution. The 3 most relevant are shown below.

IP.2. Taking out/ Adding (Pos.5) ***	IP. Str.	[Par.35][Par.3][IP(s) : 35,1,29,2] - [Par.37][Par.5][IP(s) : 2,13,18,17] - [Par.5][Par.37][IP(s) : 2,36,26,18] -
IP.12. Equipotentiality (Pos.8) ***	IP. Tac.	[Par.19][Par.3][IP(s) : 12,28,0,0] -
IP.8. Anti-Weight/ Compensation (Pos.9) ***	IP. Tac.	[Par.3][Par.19][IP(s) : 8,35,24,0] -

Inventive Principles (IP) selected for Recommended Solution:

To develop a Specific Solution based on the contradictions provided in Table V, where S1: CHIMPANZEE'S HAND interacts with S2: TERMITE IN UNDERGROUND NEST, the Innovation Team must analyze the recommended innovation concepts for each selected inventive principle listed below. At least one concept from each principle that is applicable to the challenge under evaluation should be chosen.

Once the concepts are selected per inventive principle, it is essential to conduct an 'integrated reading' of the contradictions indicated in Table V. If this 'integrated reading' can demonstrate a coherent logical thread for each selected contradiction and as a whole, then it can be considered that there is a potential innovation solution.

To complete the definition of the specific solution, it is necessary to review the relevant inventive principles from Table II that were not included in the Recommended Solution in Table V, which are presented above.

For more details on the selected contradictions, you can review the complete descriptions of the inventive principles by contradiction, as shown in Table IX.

In the Starting Manual, Fundamentals of Aatrizinventor, Point 11, an example is provided for developing the Specific Solution based on the Recommended Solution by the Aatrizinventor algorithm, based on the 'Language of Nature Innovation.' The identification of a specific solution is a systematic and iterative process involving multiple concepts, aiming to determine a comprehensive solution with minimal

implementation costs and maximum benefit-to-cost ratio.

It's important noting that an asterisk (*) has been added to the name of the object under evaluation to remind that the descriptions of the inventive principles may consider that CHIMPANZEE'S HAND can be in its current physical and functional state, or in a modified state, or even in a new state, as needed to achieve the desired objective. Please, make the most of your relational thinking skills.

Summary description of the Inventive Principles included in the Recommended Solution shown above, applicable to the challenge under evaluation for the defined space and time:

N°1 Improve: (-) 3. Length of moving object and Attenuate or Preserve: (-) 35. Adaptability or versatility

IP.14. Spheroidality - Curvature - Angle - tactical type (1)

- a. For the interaction between CHIMPANZEE'S HAND* and Object S2, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.
- b. For the interaction between CHIMPANZEE'S HAND* and Object S2, instead of acting in a linear or direct way, interact in an indirect way or with curvilinear, surrounding, or angled movements.
- c. Move CHIMPANZEE'S HAND* from flat to spherical surfaces; from parts shaped as a cube (parallelepiped) to ball-shaped structures.
- d. Use rolls, balls, spirals, domes in, or for, CHIMPANZEE'S HAND*.
- e. Go from linear to rotary motion, use centrifugal forces in, or for, CHIMPANZEE'S HAND*.
- f. If there is Spheroidality, curvature or angle, increase or reduce, as applicable, in, or for, CHIMPANZEE'S HAND*.

IP.15. Dynamics - strategic type (2)

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

IP.1. Segmenting/ Integrating - strategic type (3)

- a. Divide CHIMPANZEE'S HAND* into existing and/or new parts, shapes, phases, states, or conditions.
- b. Integrate different existing or new parts, forms, phases, states or conditions of CHIMPANZEE'S HAND* in a single entity.
- c. Make CHIMPANZEE'S HAND* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of CHIMPANZEE'S HAND*.

IP.16. Partial or Excessive Actions - operative type (4)

- a. If the objective of CHIMPANZEE'S HAND* in its interaction with TERMITE IN UNDERGROUND NEST is difficult to fully achieve using a given solution, then use 'a little less' or 'a little more' of the same solution.

N°2 Improve: (+) 37. Difficulty of detecting and measuring and Attenuate or Preserve: (-) 35.

Adaptability or versatility

IP.1. Segmenting/ Integrating - strategic type (5)

- a. Divide CHIMPANZEE'S HAND* into existing and/or new parts, shapes, phases, states, or conditions.
- b. Integrate different existing or new parts, forms, phases, states or conditions of CHIMPANZEE'S HAND* in a single entity.

- c. Make CHIMPANZEE'S HAND* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of CHIMPANZEE'S HAND*.

IP.15. Dynamics - strategic type (6)

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

N°3 Improve: (+) 19. Use of energy by moving object and Attenuate or Preserve: (-) 35. Adaptability or versatility

IP.15. Dynamics - strategic type (7)

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

IP.17. Another Dimension or Field - tactical type (8)

- a. Add or remove physical dimensions or fields of action of CHIMPANZEE'S HAND*.
- b. Move CHIMPANZEE'S HAND* to a new dimension in space or performance field.
- c. Use for CHIMPANZEE'S HAND* multi-story arrangement of objects instead of a single-story arrangement.
- d. Tilt or re-orient CHIMPANZEE'S HAND*; lay it on its side.
- e. Use another side of a given dimension or field of CHIMPANZEE'S HAND*.

IP.13. Reverse or Indirect Action - strategic type (9)

- a. Inverse the applied action or apply an indirect action to perform the current function of CHIMPANZEE'S HAND* to interact with object S2 It should be identified how CHIMPANZEE'S HAND* currently performs an action with Object S2 and from there evaluate an inverse or indirect action.
- b. Make moving parts of CHIMPANZEE'S HAND* (or the external environment) fixed, and fixed parts moving.
- c. Turn CHIMPANZEE'S HAND* (or process) 'upside down', 'change the position', 'change the condition'.

IP.16. Partial or Excessive Actions - operative type (10)

- a. If the objective of CHIMPANZEE'S HAND* in its interaction with TERMITE IN UNDERGROUND NEST is difficult to fully achieve using a given solution, then use 'a little less' or 'a little more' of the same solution.

N°4 Improve: (-) 3. Length of moving object and Attenuate or Preserve: (+) 37. Difficulty of detecting and measuring

IP.35. Transformation / Parameter Changes - strategic type (11)

- a. Change CHIMPANZEE'S HAND*'s physical or chemical state (e.g., in shape, in composition, to a gas, liquid, solid or plasma).
- b. Change the composition or condition of CHIMPANZEE'S HAND* by adding or removing components.
- c. Change the concentration or consistency; change the degree of flexibility; change the temperature or the level of internal activity of CHIMPANZEE'S HAND*.

IP.1. Segmenting/ Integrating - strategic type (12)

- a. Divide CHIMPANZEE'S HAND* into existing and/or new parts, shapes, phases, states, or conditions.
- b. Integrate different existing or new parts, forms, phases, states or conditions of CHIMPANZEE'S HAND* in a single entity.
- c. Make CHIMPANZEE'S HAND* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of CHIMPANZEE'S HAND*.

IP.26. Copying/ Replicating - strategic type (13)

- a. Instead of using CHIMPANZEE'S HAND*, or any of its unavailable, expensive, fragile parts or properties, use simpler and inexpensive copies or replicates to perform the desired function and, if possible, do so with improved characteristics and properties, while disregarding the harmful, undesirable, or unnecessary ones.
- b. Imitate CHIMPANZEE'S HAND*, or any of its parts or properties, leveraging the relevant available environment.
- c. If simple copies, or replicates are already being used, apply copies, or replicates of a higher level or technical

IP.24. Intermediary - tactical type (14)

- a. for CHIMPANZEE'S HAND*, use an intermediary carrier article or intermediary process.
- b. Merge CHIMPANZEE'S HAND* temporarily with another object (which can be easily removed or removed by itself).

N°5 Improve: (+) 5. Area of moving object and Attenuate or Preserve: (-) 35. Adaptability or versatility

IP.15. Dynamics - strategic type (15)

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

IP.30. Simple Shapes/ Ways to Interact - tactical type (16)

- a. Use flexible rods and ropes, or similar one-dimensional functionality, or shells and thin films, or similar two-dimensional functionality, for CHIMPANZEE'S HAND*, instead of complex three-dimensional structures, in type and number of components and shapes.
- b. Separate/isolate CHIMPANZEE'S HAND* from the external environment with simple shapes, using flexible rods and ropes, or similar one-dimensional, or shells and thin films, or similar two-dimensional.
- c. Use in or for CHIMPANZEE'S HAND* simple forms or ways of interacting with object S2, predominantly in one or two dimensions, with other dimensions reduced to a minimum. This is in order to reduce the number of resources and actions necessary to achieve the desired objective.

N°6 Improve: 19. Use of energy by moving object and Preserve: 27. Reliability

IP.19. Time-Varying Action/ Periodic or Pulsating - strategic type (17)

- a. Instead of using continuous action in, or for, CHIMPANZEE'S HAND*, use time-varying, periodic, or pulsating actions.
- b. If the action of CHIMPANZEE'S HAND* is already periodic, change the periodic magnitude or frequency.
- c. Use pauses between impulses to perform a different action of CHIMPANZEE'S HAND*.

d. If the current action of CHIMPANZEE'S HAND* is time-varying, and if necessary, change to an action higher or lesser time-varying.

IP.21. Skipping/ Avoiding - tactical type (18)

- a. Make sure that with CHIMPANZEE'S HAND*, the process, or certain stages (e.g., destructible, harmful, or hazardous operations), are conducted at high speed or during a minimum time of exposure to the risk.
- b. Eventually, skip certain process stages CHIMPANZEE'S HAND*.

IP.11. Beforehand Cushioning - tactical type (19)

- a. Prepare emergency means, beforehand, to compensate for the relatively low reliability of CHIMPANZEE'S HAND*.

IP.27. Cheap Short-Living Objects - strategic type (20)

- a. Replace or divide (either fully or partially) CHIMPANZEE'S HAND* or its action with multiple inexpensive or short-living objects, actions, or sub-parts, which compress or simplify its characteristics and properties, and/or are limited but sufficient to achieve the desired objective.
- b. Compress certain qualities of CHIMPANZEE'S HAND* (e.g., the degree of participation, complexity, or lifetime), with no loss of functionality, to achieve the desired objective.

N°7 Improve: 19. Use of energy by moving object and Preserve: 15. Duration of action of moving object

IP.28. Mechanics Substitution - strategic type (21)

- a. Replace a direct or manual action in, or for, CHIMPANZEE'S HAND*, with a mechanical action or a tool.
- b. Replace a mechanical means in, or for, CHIMPANZEE'S HAND*, with sensory (optical, acoustic, vibration, taste, smell, feelings or other sensory fields) means.
- c. Use mechanical, pneumatic, hydraulic, electric, magnetic, and electromagnetic, chemical, biological, psychological or other fields to improve action of CHIMPANZEE'S HAND*.
- d. Change from static fields in, or for, CHIMPANZEE'S HAND* to moving fields, from unstructured fields to those with structure, or vice versa.
- e. Use fields in conjunction with field-activated parts, components, or particles (e.g., magnetic field and ferromagnetic particles) in, or for, CHIMPANZEE'S HAND*.

IP.35. Transformation / Parameter Changes - strategic type (22)

- a. Change CHIMPANZEE'S HAND*'s physical or chemical state (e.g., in shape, in composition, to a gas, liquid, solid or plasma).
- b. Change the composition or condition of CHIMPANZEE'S HAND* by adding or removing components.
- c. Change the concentration or consistency; change the degree of flexibility; change the temperature or the level of internal activity of CHIMPANZEE'S HAND*.

IP.6. Universality - tactical type (23)

- a. Make a part or the whole of CHIMPANZEE'S HAND* perform multiple functions.
- b. Eliminate the need of CHIMPANZEE'S HAND* for others parts.

IP.18. Mechanical Vibrations/ Energy Variations - tactical type (24)

- a. Move CHIMPANZEE'S HAND* by cycles with energies that activate it.
- b. Cause CHIMPANZEE'S HAND* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of CHIMPANZEE'S HAND*. If necessary, decrease frequency.
- c. Use vibration-generating fields in, or for, CHIMPANZEE'S HAND* instead of mechanical vibration generators. Combine sources of oscillations.
- d. Apply alternation of CHIMPANZEE'S HAND* or its parts or functions.

N°8 Improve: and Preserve:

Relevant inventive principles from Table II not included in Recommended Solution

IP.2. Taking out/ Adding (Pos.(5) - strategic type (25)

a. Separate an interfering part or a property from CHIMPANZEE'S HAND*, or single out the only necessary part (or property) of CHIMPANZEE'S HAND*. b. Add new parts or properties to CHIMPANZEE'S HAND*.

IP.12. Equipotentiality (Pos.(8) - tactical type (26)

a. In a potential field, limit position changes or energy variations of CHIMPANZEE'S HAND*. b. Change operating conditions to eliminate the need to change the position or energy quality of CHIMPANZEE'S HAND* in a potential field.

(Pos.) (27)

TABLE VI. RESULTS OF SENSITIVITY ANALYSIS FOR THE EVALUATED OBJECT CHIMPANZEE'S HAND CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

Coverage obtained for the current evaluation to compare with sensitivity analysis

Order	Par.1	Par.2	Par.3	Par.4	Par.5	Cob. NS (%)	Cob. EC (%)	Cob. GL (%)
#	3	5	35	37	19. Use of energy by moving object	94.26	100	95.7

Table VI presents the 10 most favorable parameter combinations recommended by the Aatrizinventor algorithm. It is suggested to evaluate the 2 or 3 most relevant ones. Practice teaches that they often contain the best solution for the evaluated challenge.

(E) Combination of TRIZ innovation parameters evaluated in this Aatrizinventor Solution is prioritized here

A. PRIORITISED CONTRADICTIONS BY GLOBAL COVERAGE (Cob.GL)

Par.5 is automatically selected

Order	Par.1	Par.2	Par.3	Par.4	Par.5	Cob. NS (%)	Cob. EC (%)	Cob. GL (%)
I.a	3	5	35	37	19. Use of energy by moving object (E)	94.26	100	95.7
II.a	5	12	35	37	32. Ease of achieving desired outcome	98.22	81.05	93.93
III.a	3	5	35	0	19. Use of energy by moving object	91.83	100	93.87

IV.a	3	12	35	37	39. Productivity	88.68	100	91.51
V.a	3	5	37	0	19. Use of energy by moving object	93.05	84.51	90.91

B. PRIORITIZATION OF CONTRADICTIONS BY COVERAGE OF NEEDS TO SATISFY (Cob.NS)

Par.5 is automatically selected

Order	Par.1	Par.2	Par.3	Par.4	Par.5	Cob. NS (%)	Cob. EC (%)	Cob. GL (%)	Table VI.A
I.b	3	5	12	37	32. Ease of achieving desired outcome	99.11	27.42	81.19	-
II.b	3	12	35	37	32. Ease of achieving desired outcome	99.11	12.84	77.54	-
III.b	5	12	35	37	32. Ease of achieving desired outcome	98.22	81.05	93.93	II.a
IV.b	3	5	12	37	19. Use of energy by moving object	95.13	19	76.1	-
V.b	3	5	35	37	19. Use of energy by moving object (E)	94.26	100	95.7	I.a

TABLE VII ESSENTIAL CONTRADICTIONS MATRIX FOR NEEDS TO SATISFY (NS) FOR THE SAME UNDESIRABLE EFFECTS EVALUATED OF: CHIMPANZEE'S HAND

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest
Evaluated need to satisfy in this report: **19. Use of energy by moving object**

UDEs: (-) 3. Length of moving object// (+) 5. Area of moving object// (-) 35. Adaptability or versatility// (+) 37. Difficulty of detecting and measuring

This table allows the Innovation Team to compare the coverages obtained for the evaluated need to satisfy with those of the other defined needs, for the same undesirable effects. This way, they can decide whether to choose any of the suggested innovation parameter combinations here that offer better coverage.

Need to Satisfy	Parameter to improve	Parameter to attenuate or preserve	Contradict. Essential	Cob. NS (%)	Cob. between EC (%)	Cob. GL (%) 3/1
19. Use of energy by moving object	(-) 3. Length of moving object	(-) 35. Adaptability or versatility	[14,15,1,16]	94.26	100	95.7
39. Productivity	(-) 3. Length of moving object	(-) 35. Adaptability or versatility	[14,15,1,16]	82.37	100	86.78
33. Ease of operation	(-) 3. Length of moving object	(-) 35. Adaptability or versatility	[14,15,1,16]	81.38	100	86.04

13. Stability	(-) 3. Length of moving object	(-) 35. Adaptability or versatility	[14,15,1,16]	79.72	100	84.79
34. Ease of change, repair or maintain	(-) 3. Length of moving object	(-) 35. Adaptability or versatility	[14,15,1,16]	77.78	100	83.33
35. Adaptability or versatility	(-) 3. Length of moving object	(+) 35. Adaptability or versatility	[14,15,1,16]	74.87	100	81.15
38. Extent of automation/ autonomy	(-) 3. Length of moving object	(-) 35. Adaptability or versatility	[14,15,1,16]	67.7	100	75.78
32. Ease of achieving desired outcome	(-) 35. Adaptability or versatility	(-) 3. Length of moving object	[35,1,29,2]	81.64	20.78	66.43
27. Reliability	(-) 35. Adaptability or versatility	(-) 3. Length of moving object	[35,1,29,2]	73.08	20.78	60
15. Duration of action of moving object	(-) 35. Adaptability or versatility	(-) 3. Length of moving object	[35,1,29,2]	64.13	20.78	53.29

Table VII shows the essential contradictions obtained for each of the defined Needs to Satisfy, taking into account the same undesirable effects that have been evaluated. This table is based on the calculation of a global coverage (Cob.GL), which is determined by combining two values: the coverage from Table IV (Cob.NS) already explained, and a relative coverage (Cob. between EC) that is obtained in this table VII, when each other comparing the essential contradictions identified for the 10 parameters of Needs to Satisfy.

This global coverage (GL) is based on expert weighting criteria to prioritize the solutions for the different Needs to Satisfy. Experience with aatrizinventor indicates that the most effective solutions are those with higher global coverage, preferably exceeding 90%, if possible.

The Innovation Team may decide if it is appropriate to carry out a new evaluation with another Need to Satisfy, selected from the results provided in Table VII. This decision will be primarily made when the evaluated Need to Satisfy is not ranked in the first position of Table VII. In this table, the position of the evaluated Need to Satisfy is highlighted: 19. Use of energy by moving object.

TABLE VIII. ORDER OF INCIDENCE OF INVENTIVE PRINCIPLES (POS.n)

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest
Participation analysis of inventive principles in TABLE II SPECIFIC CONTRADICTION MATRIX.

Evaluated parameters for Object CHIMPANZEE'S HAND:

Par. UDEs:

(-) 3. Length of moving object

(+) 5. Area of moving object

(-) 35. Adaptability or versatility

(+) 37. Difficulty of detecting and measuring

Par. NS: (+) 19. Use of energy by moving object

***: Inventive Principles from the Specific Contradiction Matrix (Table II) not described in the Recommend Solution (Table IX). It is recommended to perform an additional review following the order of position.

Inventive principles of Table II	IP type	Tables	Contradictions
IP.35. Transformation / Parameter Changes (Pos.1)	IP. Str.	II / III / IV	[Par.35][Par.3][IP(s) : 35,1,29,2] - [Par.35][Par.5][IP(s) : 35,30,29,7] - [Par.3][Par.37][IP(s) : 35,1,26,24] - [Par.19][Par.37][IP(s) : 35,38,0,0] - [Par.3][Par.19][IP(s) : 8,35,24,0] - [Par.35][Par.19][IP(s) : 19,35,29,13] - [Par.37][Par.19][IP(s) : 35,38,0,0] -
IP.15. Dynamics (Pos.2)	IP. Str.	II / III / IV	[Par.5][Par.3][IP(s) : 14,15,18,4] - [Par.3][Par.5][IP(s) : 15,17,4,0] - [Par.19][Par.5][IP(s) : 15,19,25,0] - [Par.3][Par.35][IP(s) : 14,15,1,16] - [Par.5][Par.35][IP(s) : 15,30,0,0] - [Par.37][Par.35][IP(s) : 1,15,0,0] - [Par.19][Par.35][IP(s) : 15,17,13,16] -
IP.1. Segmenting/ Integrating (Pos.3)	IP. Str.	II / III / IV	[Par.35][Par.3][IP(s) : 35,1,29,2] - [Par.3][Par.35][IP(s) : 14,15,1,16] - [Par.37][Par.35][IP(s) : 1,15,0,0] - [Par.3][Par.37][IP(s) : 35,1,26,24] - [Par.35][Par.37][IP(s) : 1,0,0,0] -
IP.19. Time-Varying Action/ Periodic or Pulsating (Pos.4)	IP. Str.	II / IV	[Par.19][Par.5][IP(s) : 15,19,25,0] - [Par.5][Par.19][IP(s) : 19,32,0,0] - [Par.35][Par.19][IP(s) : 19,35,29,13] -
IP.2. Taking out/ Adding (Pos.5) ***	IP. Str.	II / IV	[Par.35][Par.3][IP(s) : 35,1,29,2] - [Par.37][Par.5][IP(s) : 2,13,18,17] - [Par.5][Par.37][IP(s) : 2,36,26,18] -
IP.14. Spheroidality - Curvature - Angle (Pos.6)	IP. Tac.	II / III / IV	[Par.5][Par.3][IP(s) : 14,15,18,4] - [Par.3][Par.35][IP(s) : 14,15,1,16] -
IP.16. Partial or Excessive Actions (Pos.7)	IP. Oper.	II / III / IV	[Par.37][Par.3][IP(s) : 16,17,26,24] - [Par.3][Par.35][IP(s) : 14,15,1,16] - [Par.19][Par.35][IP(s) : 15,17,13,16] -
IP.12. Equipotentiality (Pos.8) ***	IP. Tac.	II / IV	[Par.19][Par.3][IP(s) : 12,28,0,0] -
IP.8. Anti-Weight/ Compensation (Pos.9) ***	IP. Tac.	II /	[Par.3][Par.19][IP(s) : 8,35,24,0] -
IP.17. Another Dimension or Field (Pos.10)	IP. Tac.	II / III / IV	[Par.37][Par.3][IP(s) : 16,17,26,24] - [Par.3][Par.5][IP(s) : 15,17,4,0] - [Par.37][Par.5][IP(s) : 2,13,18,17] - [Par.19][Par.35][IP(s) : 15,17,13,16] -

IP.38. Strong or Quick Reactions (Pos.11) ***	IP. Oper.	II /	[Par.19][Par.37][IP(s) : 35,38,0,0] - [Par.37][Par.19][IP(s) : 35,38,0,0] -
IP.30. Simple Shapes/ Ways to Interact (Pos.12)	IP. Tac.	II / III / IV	[Par.35][Par.5][IP(s) : 35,30,29,7] - [Par.5][Par.35][IP(s) : 15,30,0,0] -
IP.13. Reverse or Indirect Action (Pos.13)	IP. Str.	II / III / IV	[Par.37][Par.5][IP(s) : 2,13,18,17] - [Par.19][Par.35][IP(s) : 15,17,13,16] - [Par.35][Par.19][IP(s) : 19,35,29,13] -
IP.36. Phase, State or Condition Transitions (Pos.14) ***	IP. Oper.	II /	[Par.5][Par.37][IP(s) : 2,36,26,18] -
IP.32. Perception/ Appearance/ Color Changes (Pos.15) ***	IP. Str.	II / IV	[Par.5][Par.19][IP(s) : 19,32,0,0] -
IP.28. Mechanics Substitution (Pos.16)	IP. Str.	II / IV	[Par.19][Par.3][IP(s) : 12,28,0,0] -
IP.29. Controllable Soft Variables (Pos.17) ***	IP. Tac.	II /	[Par.35][Par.3][IP(s) : 35,1,29,2] - [Par.35][Par.5][IP(s) : 35,30,29,7] - [Par.35][Par.19][IP(s) : 19,35,29,13] -
IP.26. Copying/ Replicating (Pos.18)	IP. Str.	II / III / IV	[Par.37][Par.3][IP(s) : 16,17,26,24] - [Par.3][Par.37][IP(s) : 35,1,26,24] - [Par.5][Par.37][IP(s) : 2,36,26,18] -
IP.18. Mechanical Vibrations/ Energy Variations (Pos.19)	IP. Tac.	II / IV	[Par.5][Par.3][IP(s) : 14,15,18,4] - [Par.37][Par.5][IP(s) : 2,13,18,17] - [Par.5][Par.37][IP(s) : 2,36,26,18] -
IP.24. Intermediary (Pos.20)	IP. Tac.	II / III / IV	[Par.37][Par.3][IP(s) : 16,17,26,24] - [Par.3][Par.37][IP(s) : 35,1,26,24] - [Par.3][Par.19][IP(s) : 8,35,24,0] -
IP.4. Asymmetry/ Symmetry (Pos.21) ***	IP. Oper.	II /	[Par.5][Par.3][IP(s) : 14,15,18,4] - [Par.3][Par.5][IP(s) : 15,17,4,0] -
IP.25. Self-service (Pos.22) ***	IP. Oper.	II /	[Par.19][Par.5][IP(s) : 15,19,25,0] -
IP.7. Nesting/ Dispersing (Pos.23) ***	IP. Tac.	II /	[Par.35][Par.5][IP(s) : 35,30,29,7] -

TABLE IX. RECOMMENDED SOLUTION ACCORDING TO THE MOST RELEVANT CONTRADICTIONS IDENTIFIED FOR THE EVALUATED OBJECT: CHIMPANZEE'S HAND

CHALLENGE: Improve Extraction of termite by a chimpanzee affected by an underground termite nest

This table displays the relevant contradictions identified by the algorithm, which are crucial for determining the direction and scope of the solution to the innovation challenge under evaluation. The specific solution will be obtained by applying the updated inventive principles detailed below.

It is essential to bear in mind that we are evaluating CHIMPANZEE'S HAND when it interacts with TERMITE IN UNDERGROUND NEST and there is an affected function: Extraction of termite by a chimpanzee affected by an underground termite nest, in a specific space and time. CHIMPANZEE'S HAND may require changes in space, time, its physical composition, or its functional characteristic, as well as partial or total replacement with another object or other recommended changes. To emphasize this concept, we mark CHIMPANZEE'S HAND with an asterisk. Do not read the name of the evaluated object literally; associate it with a possible solution for CHIMPANZEE'S HAND*.

Each inventive principle described here may contain more than one innovation concept recommended by TRIZ, identified as a, b, c, ..., not all of which are applicable to a specific case under evaluation. The Innovation Team must select those innovation concepts that best relate to the evaluated innovation challenge, based on their own knowledge and the analysis of relational thinking that they must carry out.

Additionally, technological research may be necessary for its solution, as the specific solution recommended by the inventive principles described here likely already exists somewhere in the world. The interpretation of the inventive principles, to apply them specifically to the evaluated case, is a recursive process that generally ranges from strategic to tactical and operational levels. We recommend completing the reading of the inventive principles described below to envision a possible solution and then rereading the principles to reinforce the coherence of the emerging solution. As a result of the finally determined innovation solution, there will be a change in CHIMPANZEE'S HAND, in a new context guided by the inventive principles, probably not previously imagined.

The Language of Nature's Innovation provides speed and focus for guided and systematic innovation thinking for individuals. The foundation for innovation is a profound understanding of the current situation.

IX.A BASE SOLUTION FOR INNOVATION CHALLENGE FOR THE EVALUATED OBJECT CHIMPANZEE'S HAND NEED TO SATISFY: 19. Use of energy by moving object

Strategic inventive principles: Str. IP

Tactical inventive principles: Tac. IP

Operative inventive principles: Oper. IP

Pos.n : Order of importance n of an inventive principle included in Table II.

ESSENTIAL CONTRADICTION

Contradiction order wt.1

Parameter to improve: (-) 3. Length of moving object

TO IMPROVE (UDE): CHIMPANZEE'S HAND has Less Own length or relative distance, whether physical or figurative interacting with S2

Parameter to attenuate or preserve: (-) 35. Adaptability or versatility

TO ATTENUATE OR PRESERVE (UDE): CHIMPANZEE'S HAND has Less Adaptability or versatility to interaction variability of S2

Inventive principles IP(s) : [14,15,1,16]

14. Spheroidality – Curvature - Angle, Tac. IP (Pos.6):

- a. For the interaction between CHIMPANZEE'S HAND* and S2 Object, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.
- b. For the interaction between CHIMPANZEE'S HAND* and S2 Object, instead of acting in a linear or direct way, interact in an indirect way or with curvilinear, surrounding, or angled movements.
- c. Move CHIMPANZEE'S HAND* from flat to spherical surfaces; from parts shaped as a cube (parallelepiped) to ball-shaped structures.
- d. Use rolls, balls, spirals, domes in, or for, CHIMPANZEE'S HAND*.
- e. Go from linear to rotary motion, use centrifugal forces in, or for, CHIMPANZEE'S HAND*.
- f. If there is Spheroidality, curvature or angle, increase or reduce, as applicable, in, or for, CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation alternative

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving if a solution has not yet emerged

15. Dynamics, Str. IP (Pos.2):

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

1. Segmenting/ Integrating, Str. IP (Pos.3):

- a. Divide CHIMPANZEE'S HAND* into existing and/or new parts, shapes, phases, states, or conditions.
- b. Integrate different parts, shapes, phases, states, or existing or new conditions of a CHIMPANZEE'S HAND* into a single entity..
- c. Make CHIMPANZEE'S HAND* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation in space / Separation in subsystem

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

16. Partial or Excessive Actions, Oper. IP (Pos.7):

- a. If the goal of CHIMPANZEE'S HAND* is hard to achieve fully, using a given solution's method; then the problem may be considerably easier to solve, using "slightly less" or "slightly more" of the same method.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving performance

COMPLEMENTARY CONTRADICTION 1

Contradiction order wt.3

Parameter to improve: (+) 37. Difficulty of detecting and measuring

TO IMPROVE (UDE): CHIMPANZEE'S HAND has More Difficulty in detection and measurement interacting with S2

Parameter to attenuate or preserve: (-) 35. Adaptability or versatility

TO ATTENUATE OR PRESERVE (UDE): CHIMPANZEE'S HAND has Less Adaptability or versatility to interaction variability of S2

Inventive principles IP(s) : [1,15,0,0]

1. Segmenting/ Integrating, Str. IP (Pos.3):

- a. Divide CHIMPANZEE'S HAND* into existing and/or new parts, shapes, phases, states, or conditions.
- b. Integrate different parts, shapes, phases, states, or existing or new conditions of a CHIMPANZEE'S HAND* into a single entity..
- c. Make CHIMPANZEE'S HAND* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation in space / Separation in subsystem

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

15. Dynamics, Str. IP (Pos.2):

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

COMPLEMENTARY CONTRADICTION 2

Contradiction order wt.4

Parameter to improve: (+) 19. Use of energy by moving object

TO IMPROVE (DE): CHIMPANZEE'S HAND has More Efficient energy use to interact with S2

Parameter to attenuate or preserve: (-) 35. Adaptability or versatility

TO ATTENUATE OR PRESERVE (UDE): CHIMPANZEE'S HAND has Less Adaptability or versatility to interaction variability of S2

Inventive principles IP(s) : [15,17,13,16]

15. Dynamics, Str. IP (Pos.2):

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

17. Another Dimension or Field, Tac. IP (Pos.10):

- a. Add or remove physical dimensions or fields of action of CHIMPANZEE'S HAND*.
- b. Move CHIMPANZEE'S HAND* to a new dimension in space or performance field.
- c. Use for CHIMPANZEE'S HAND* multi-story arrangement of objects instead of a single-story arrangement.
- d. Tilt or re-orient CHIMPANZEE'S HAND*; lay it on its side.
- e. Use another side of a given dimension or field of CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation in space

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

13. Inverse or Indirect Action, Str. IP (Pos.13):

- a. Inverse the applied action or apply an indirect action to perform the current function of CHIMPANZEE'S HAND* to interact with object (S2)

It should be identified how CHIMPANZEE'S HAND* currently performs an action with S2 Object and from there evaluate an inverse or indirect action.

- b. Make moving parts of CHIMPANZEE'S HAND* (or the external environment) fixed, and fixed parts moving.
- c. Turn CHIMPANZEE'S HAND* (or process) “upside down”, “change the position”, “change the condition”.

Separation principle for CHIMPANZEE'S HAND* : Separation in space / Separation inverse

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

16. Partial or Excessive Actions, Oper. IP (Pos.7):

- a. If the goal of CHIMPANZEE'S HAND* is hard to achieve fully, using a given solution's method; then the problem may be considerably easier to solve, using “slightly less” or “slightly more” of the same method.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving performance

COMPLEMENTARY CONTRADICTION 3

Contradiction order wt.6

Parameter to improve: (-) 3. Length of moving object

TO IMPROVE (UDE): CHIMPANZEE'S HAND has Less Own length or relative distance, whether physical or figurative interacting with S2

Parameter to attenuate or preserve: (+) 37. Difficulty of detecting and measuring

TO ATTENUATE OR PRESERVE (UDE): CHIMPANZEE'S HAND has More Difficulty in detection and measurement interacting with S2

Inventive principles IP(s) : [35,1,26,24]

35. Transformation/ Parameter Changes, Str. IP (Pos.1):

- a. Change CHIMPANZEE'S HAND*'s physical or chemical state (e.g., in shape, in composition, to a gas, liquid, solid or plasma).

- b. Change the composition or condition of CHIMPANZEE'S HAND* by adding or removing components.
- c. Change the concentration or consistency; change the degree of flexibility; change the temperature or the level of internal activity of CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation by condition / Separation alternative

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

1. Segmenting/ Integrating, Str. IP (Pos.3):

- a. Divide CHIMPANZEE'S HAND* into existing and/or new parts, shapes, phases, states, or conditions.
- b. Integrate different parts, shapes, phases, states, or existing or new conditions of a CHIMPANZEE'S HAND* into a single entity..
- c. Make CHIMPANZEE'S HAND* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation in space / Separation in subsystem

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

26. Copying/ Replicating, Str. IP (Pos.18):

- a. Instead of using CHIMPANZEE'S HAND*, or any of its unavailable, expensive, fragile parts or properties, use simpler and inexpensive copies or replicates to perform the desired function and, if possible, do so with improved characteristics and properties, while disregarding the harmful, undesirable, or unnecessary ones.
- b. Imitate or replicate CHIMPANZEE'S HAND*, or any of its parts or properties, leveraging the relevant available environment.
- c. If simple copies, or replicates are already being used, apply copies, or replicates of a higher level or technical complexity.

Separation principle for CHIMPANZEE'S HAND* : Separation in space

Solution strategy for CHIMPANZEE'S HAND* : Improving if a solution has not yet emerged

24. Intermediary, Tac. IP (Pos.20):

- a. for CHIMPANZEE'S HAND*, use an intermediary carrier article or intermediary process.
- b. Merge CHIMPANZEE'S HAND* temporarily with another object (which can be easily removed or removed by itself).

Separation principle for CHIMPANZEE'S HAND* : Separation in space

Solution strategy for CHIMPANZEE'S HAND* : Improving if a solution has not yet emerged

COMPLEMENTARY CONTRADICTION 4

Contradiction order wt.9

Parameter to improve: (+) 5. Area of moving object

TO IMPROVE (UDE): CHIMPANZEE'S HAND has More Own area or two-dimensional scope interacting with S2

Parameter to attenuate or preserve: (-) 35. Adaptability or versatility

TO ATTENUATE OR PRESERVE (UDE): CHIMPANZEE'S HAND has Less Adaptability or versatility to interaction variability of S2

Inventive principles IP(s) : [15,30,0,0]

15. Dynamics, Str. IP (Pos.2):

- a. Allow (or design) the characteristics of CHIMPANZEE'S HAND*, external environment, or process to change to an optimal, or to find an optimal, operating condition.
- b. Divide CHIMPANZEE'S HAND* into parts that are capable of relative movement between each other.
- c. If CHIMPANZEE'S HAND* (or process) is rigid or inflexible, make it flexible or adaptive.
- d. To enhance the dynamics of CHIMPANZEE'S HAND* or the process, use feature(s) or object(s) available in the nearby environment.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); Improving if a solution has not yet emerged

30. Simple Shapes/ Ways to Interact, Tac. IP (Pos.12):

- a. Use flexible rods and ropes, or another option with similar one-dimensional functionality, or shells and thin films, or another option with similar two-dimensional functionality, for CHIMPANZEE'S HAND*, instead of complex three-dimensional structures, in type and number of components and shapes.
- b. Separate/isolate CHIMPANZEE'S HAND* from the external environment with simple shapes, using flexible rods and ropes, or another option with similar one-dimensional functionality, or shells and thin films, or another option with similar two-dimensional functionality.
- c. Instead of using complex forms or methods with CHIMPANZEE'S HAND* to interact with S2 Object, one should use simpler ways or methods, employing flexible objects or means, either physical or conceptual, operating predominantly in one or two dimensions, with other dimensions to the minimum. This is in order to reduce the number of resources and actions necessary to achieve the desired objective.

Separation principle for CHIMPANZEE'S HAND* : Separation in space

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes

IX.B SOLUTION TO MORE RELEVANT CONTRADICTIONS BETWEEN NEEDS TO SATISFY (Cob.NS)

Included in each inventive principle described below is the incidence level or position number it occupies in Table II. If it is not shown, it means that it only appears in Table IV. and requires attention.

CONTRADICTION BETWEEN NEEDS TO SATISFY N° 1

Parameter to improve 19. Use of energy by moving object

MEJORAR > CHIMPANZEE'S HAND tiene More Efficient energy use to interact with S2

Parameter to preserve 27. Reliability

PRESERVAR > CHIMPANZEE'S HAND tiene más efecto deseable por párametro 27. Reliability

Inventive principles IP(s) : [19,21,11,27]

19. Time-Varying Action/ Periodic or Pulsating, Str. IP (Pos.4):

- a. Instead of using continuous action in, or for, CHIMPANZEE'S HAND*, use time-varying, periodic, or pulsating actions.
- b. If the action of CHIMPANZEE'S HAND* is already periodic, change the periodic magnitude or frequency.
- c. Use pauses between impulses to perform a different action of CHIMPANZEE'S HAND*.
- d. If the current action of CHIMPANZEE'S HAND* is time-varying, and if necessary, change to an action higher or lesser time-varying.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving performance

21. Skipping/ Avoiding, Tac. IP (Pos.):

- a. Make sure that with CHIMPANZEE'S HAND*, the process, or certain stages (e.g., destructible, harmful,

or hazardous operations), are conducted at high speed or during a minimum time of exposure to the risk.

b. Eventually, skip certain process stages CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving performance

11. Beforehand Cushioning, Tac. IP (Pos.):

a. Prepare emergency means, beforehand, to compensate for the relatively low reliability of CHIMPANZEE'S HAND*.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

27. Cheap Short-Living Objects, Str. IP (Pos.):

a. Replace or divide (either fully or partially) CHIMPANZEE'S HAND* or its action with multiple inexpensive or short-living objects, actions, or sub-parts, which compress or simplify its characteristics and properties, and/or are limited but sufficient to achieve the desired objective.

b. Comprising certain qualities of CHIMPANZEE'S HAND* (e.g., the degree of participation, complexity, or lifetime), with no loss of functionality, to achieve the desired objective.

Separation principle for CHIMPANZEE'S HAND* : Separation in subsystem

Solution strategy for CHIMPANZEE'S HAND* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

CONTRADICTION BETWEEN NEEDS TO SATISFY N° 2

Parameter to improve 19. Use of energy by moving object

MEJORAR > CHIMPANZEE'S HAND tiene More Efficient energy use to interact with S2

Parameter to preserve 15. Duration of action of moving object

PRESERVAR > CHIMPANZEE'S HAND tiene más efecto deseable por párametro 15. Duration of action of moving object

Inventive principles IP(s) : [28,35,6,18]

28. Mechanics Substitution, Str. IP (Pos.16):

a. Replace a direct or manual action in, or for, CHIMPANZEE'S HAND* , with a mechanical action or a tool.

b. Replace a mechanical means in, or for, CHIMPANZEE'S HAND* , with sensory (optical, acoustic, vibration, taste, smell, feelings or other sensory fields) means.

c. Use mechanical, pneumatic, hydraulic, electric, magnetic, and electromagnetic, chemical, biological, psychological or other fields to improve action of CHIMPANZEE'S HAND* .

d. Change from static fields in, or for, CHIMPANZEE'S HAND* to moving fields, from unstructured fields to those with structure, or vice versa.

e. Use fields in conjunction with field-activated parts, components, or particles (e.g., magnetic field and ferromagnetic particles) in, or for, CHIMPANZEE'S HAND* .

Separation principle for CHIMPANZEE'S HAND* : Separation by condition

Solution strategy for CHIMPANZEE'S HAND* : Improving attributes

35. Transformation/ Parameter Changes, Str. IP (Pos.1):

a. Change CHIMPANZEE'S HAND*'s physical or chemical state (e.g., in shape, in composition, to a gas, liquid, solid or plasma).

b. Change the composition or condition of CHIMPANZEE'S HAND* by adding or removing components.

c. Change the concentration or consistency; change the degree of flexibility; change the temperature or the level of internal activity of CHIMPANZEE'S HAND* .

Separation principle for CHIMPANZEE'S HAND* : Separation by condition / Separation alternative
 Solution strategy for CHIMPANZEE'S HAND* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

6. Universality, Tac. IP (Pos.):

- a. Make a part or the whole of CHIMPANZEE'S HAND* perform multiple functions.
- b. Eliminate the need of CHIMPANZEE'S HAND* for others parts.

Separation principle for CHIMPANZEE'S HAND* : Separation alternative

Solution strategy for CHIMPANZEE'S HAND* : Improving if a solution has not yet emerged

18. Mechanical Vibrations/ Energy Variations, Tac. IP (Pos.19):

- a. Move CHIMPANZEE'S HAND* by cycles with energies that activate it
- b. Cause CHIMPANZEE'S HAND* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of CHIMPANZEE'S HAND*. If necessary, decrease frequency.
- c. Use vibration-generating fields in, or for, CHIMPANZEE'S HAND* instead of mechanical vibration generators. Combine sources of oscillations (e.g., ultrasonic, and electromagnetic).
- d. Apply alternation of CHIMPANZEE'S HAND* or its functions.

Separation principle for CHIMPANZEE'S HAND* : Separation in time

Solution strategy for CHIMPANZEE'S HAND* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

Anexo

List of applicable Inventive Principles for Innovation Solutions

IP.1. Segmenting/ Integrating	IP.21. Skipping/ Avoiding
IP.2. Taking out/ Adding	IP.22. Convert harm in benefit
IP.3. Local Quality	IP.23. Feedback
IP.4. Asymmetry/ Symmetry	IP.24. Intermediary
IP.5. Merging/ Separating	IP.25. Self-service
IP.6. Universality	IP.26. Copying/ Replicating
IP.7. Nesting/ Dispersing	IP.27. Cheap Short-Living Objects
IP.8. Anti-Weight/ Compensation	IP.28. Mechanics Substitution
IP.9. Preliminary Anti-action	IP.29. Controllable Soft Variables
IP.10. Preliminary Action	IP.30. Simple Shapes/ Ways to Interact
IP.11. Beforehand Cushioning	IP.31. 31.Using/ Removing Unused Parts
IP.12. Equipotentiality	IP.32. Perception/ Appearance/ Color Changes
IP.13. Reverse or Indirect Action	IP.33. Homogeneity / Compatibility
IP.14. Spheroidality - Curvature - Angle	IP.34. Discarding and Recovering
IP.15. Dynamics	P.35. Transformation / Parameter Changes
IP.16. Partial or Excessive Actions	IP.36. Phase, State or Condition Transitions

IP.17. Another Dimension or Field	IP.37. Useful Perceptible Change
IP.18. Mechanical Vibrations/ Energy Variations	IP.38. Strong or Quick Reactions
IP.19. Time-Varying Action/ Periodic or Pulsating	IP.39. Inert Atmosphere / Environment
IP.20. Continuity of Useful Action	IP.40. Composite Materials/ Conditions

Available Aatrizinventor solutions: 0 - You can get more solutions in home page link.

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