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

INNOVATION CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

APLICATION 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.

FACTORS OF INNOVATION:
FUNCTION AFFECTED: Hot coffee service in plastic cup affected by burning customers' hand
PHYSICAL VARIABLE OR CHARACTERISTIC: Less Safety for serving hot coffee
S1 OBJECT: PLASTIC CUP Type: Moving
S2 OBJECT: CUSTOMERS Type: Moving
DESIRED ACTION VERB: Improve

INNOVATION CHALLENGE:
CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand
DESIRED GOAL: More Safety for serving hot coffee
EVALUATED OBJECT: PLASTIC CUP
NEED TO SATISFY > 13. Stability

SELECTED INNOVATION PARAMETERS TO EVALUATE:
A. UNDESIRABLE EFFECTS CAUSES OF DISSATISFACTION (UDEs)
There are More difficulty to Improve Hot coffee service in plastic cup affected by burning customers' hand because:
PLASTIC CUP Has More Heaviness, value, cost, or restriction, whether physical or figurative interacting with S2
PLASTIC CUP Has Less Loss of substance or relevant value, interacting with S2
PLASTIC CUP Has Less Loss of time or causes a bottleneck interacting with S2
PLASTIC CUP Has Less Achievement of desired outcome interacting with S2
There are undesirable effects that cause dissatisfaction because:
There is Less Safety for serving hot coffee
B. DESIRED EFFECT FOR NEED TO SATISFY
There is More ease to Improve Hot coffee service in plastic cup affected by burning customers' hand because:
PLASTIC CUP Has More Desired stability to interact with S2
There is desirable effect for need to satisfy because:
There is More Safety for serving hot coffee

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

CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

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 PLASTIC CUP has:**
Parámeters of undesirable effects (UDE):	**Undesirable effects causes of dissatisfaction:**
(+) 1. Heaviness of moving object	More Heaviness, value, cost, or restriction, whether physical or figurative interacting with S2
(-) 23. Loss of substance	Less Loss of substance or relevant value, interacting with S2
(-) 25. Loss of Time	Less Loss of time or causes a bottleneck interacting with S2
(-) 29. Fulfillment of desired outcome	Less Achievement of desired outcome interacting with S2
Desirable parameter (DE):	**Desirable Effect for Need to satisfy:**
(+) 13. Stability	More Desired stability to interact with S2
TRIZ undesirables parameters for sensitivity analysis	**It is understood as PLASTIC CUP has:**
(-) 12. Shape / composition / configuration	Less Appropriate shape, composition, or configuration interacting with S2
(+) 17. Temperature/ Level of internal activity	More Temperature or level of internal activity interacting with S2
(+) 31. Object-generated harmful factors	More Harmful factors affecting S2 by mutual interaction
n/a	
n/a	

EVALUTION RESULTS TABLES

TABLE II. SPECIFIC CONTRADICTION MATRIX FOR UNDESIRABLE EFFECTS AND NEED TO SATISFY. FOR EVALUATED OBJECT: PLASTIC CUP AND NEED TO BE SATISFIED > 13. Stability

CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

(*) Preferred parameters: Improve 1. Heaviness of moving object & Attenuate or preserve 25. Loss of Time. 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.1	(-) Par.23	**(-) Par.25 PREF.**	(-) Par.29	(+) Par.13	Sum wt
(+) 1. Heaviness of moving object PREF.	wt		**wt.10 Compl.**	**wt.3 Compl.**	**wt.2 Compl.**	**wt.19 Compl.**	79%
	IP(s)	0,0,0,0	5,35,3,31	10,35,20,28	28,35,26,18	1,35,19,39	
(-) 23. Loss of substance	wt	wt.20		**wt.1 E.C.**	**wt.4 Top 5**	wt.16	78%
	IP(s)	35,6,23,40	0,0,0,0	15,18,35,10	35,10,24,31	2,14,30,40	
(-) 25. Loss of Time	wt	wt.11	wt.8		wt.7	wt.15	46%
	IP(s)	10,20,37,35	35,18,10,39	0,0,0,0	24,26,28,18	35,3,22,5	
(-) 29. Fulfillment of desired outcome	wt	wt.12	**wt.4 Top 5**	**wt.6 Compl.**		wt.13	52%
	IP(s)	28,32,13,18	35,31,10,24	32,26,28,18	0,0,0,0	30,18,0,0	
(+) 13. Stability	wt	wt.9	wt.16	**wt.14 Compl.**	wt.18		29%
	IP(s)	21,35,2,39	2,14,30,40	35,27,0,0	18,0,0,0	0,0,0,0	
Sum wt		32%	52%	100%	75%	25%	

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:

a) The algorithm identifies the top 5 contradictions from the entire Table II and highlights those that are outside the preferred parameters for further review.

b) 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: PLASTIC CUP
NEED TO SATISFY > 13. Stability
CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

Table II Selection: Essential Contradiction wt.1 y Complementary contradictions with preferred parameters (*) wt.2/wt.3/wt.6/wt.10							
Parameter to improve	Parameter to attenuate or preserve	Contradict.	Wt.n	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
(-) 23. Loss of substance	(-) 25. Loss of Time	Essential	wt.1	**15 Es.**	**18 Es.**	**35 Es.**	**10 Es.**
(+) 1. Heaviness of moving object	(-) 29. Fulfillment of desired outcome	Compl. 1	wt.2	28	**35 Es.**	26	**18 Es.**
(+) 1. Heaviness of moving object	(-) 25. Loss of Time	Compl. 2	wt.3	**10 Es.**	**35 Es.**	20	28
(-) 29. Fulfillment of desired outcome	(-) 25. Loss of Time	Compl. 3	wt.6	32	26	28	**18 Es.**
(+) 1. Heaviness of moving object	(-) 23. Loss of substance	Compl. 4	wt.10	5	**35 Es.**	3	31

Inventive Principles (IP) selected for the Base Solution
IP.15. Dynamics - strategic type
IP.18. Mechanical Vibrations/ Energy Variations - tactical type
IP.35. Transformation / Parameter Changes - strategic type
IP.10. Preliminary Action - strategic type
IP.28. Mechanics Substitution - strategic type
IP.26. Copying/ Replicating - strategic type
IP.20. Continuity of Useful Action - **operative type**
IP.32. Perception/ Appearance/ Color Changes - strategic type
IP.5. Merging/ Separating - **operative type**
IP.3. Local Quality - strategic type
IP.31. Using/ Removing Unused Parts - **operative 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: PLASTIC CUP, NEED TO BE SATISFY: 13. Stability

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
13. Stability	38. Extent of automation/ autonomy	1	**8 nT2**	35	0
13. Stability	35. Adaptability or versatility	35	30	**34 nT2**	2
13. Stability	34. Ease of change, repair or maintain	2	35	10	**16 nT2**
13. Stability	33. Ease of operation	32	35	30	0
13. Stability	32. Ease of achieving desired outcome	35	19 nT3	0	0
13. Stability	19. Use of energy by moving object	13 nT3	19 nT3	0	0
13. Stability	39. Productivity	23 nT3	35	40 nT3	3
13. Stability	27. Reliability	0	0	0	0
13. Stability	13. Stability	0	0	0	0
13. Stability	15. Duration of action of moving object	13 nT3	27 nT3	10	35

Inventive Principles (IP) selected for the Solution of relevant Contradictions between Needs to Satisfy
IP.1. Segmenting/ Integrating - strategic tpe
IP.8. Anti-Weight/ Compensation - tactical type
IP.35. Transformation / Parameter Changes - strategic tpe
IP.30. Simple Shapes/ Ways to Interact - tactical type
IP.34. Discarding and Recovering - tactical type
IP.2. Taking out/ Adding - strategic tpe
IP.10. Preliminary Action - strategic tpe
IP.16. Partial or Excessive Actions - **operative type**

95.17 % 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 PLASTIC CUP.
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 PLASTIC CUP
CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand
Evaluated need to satisfy in this report: **13. Stability**
UDEs: (+) 1. Heaviness of moving object// (-) 23. Loss of substance// (-) 25. Loss of Time// (-) 29. Fulfillment of desired outcome

Parameter to improve	Parameter to attenuate or preserve	Contradict.	Wt.n	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
(-) 23. Loss of substance	(-) 25. Loss of Time	Essential	wt.1	**15 Es.**	**18 Es.**	**35 Es.**	**10 Es.**
(+) 1. Heaviness of moving object	(-) 29. Fulfillment of desired outcome	Compl. 1	wt.2	28	**35 Es.**	26	**18 Es.**
(+) 1. Heaviness of moving object	(-) 25. Loss of Time	Compl. 2	wt.3	**10 Es.**	**35 Es.**	20	28
(-) 29. Fulfillment of desired outcome	(-) 25. Loss of Time	Compl. 3	wt.6	32	26	28	**18 Es.**
(+) 1. Heaviness of moving object	(-) 23. Loss of substance	Compl. 4	wt.10	5	**35 Es.**	3	31
13. Stability	38. Extent of automation/ autonomy	NS.1	wns.1	1	8	**35 Es.**	0

13. Stability	35. Adaptability or versatility	NS.2	wns.2	**35 Es.**	30	34	2
13. Stability	34. Ease of change, repair or maintain	NS.3	wns.3	2	**35 Es.**	**10 Es.**	16

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.24. Intermediary (Pos.8) ***	IP. Tac.	[Par.29][Par.23][IP(s) : 35,31,10,24] - [Par.23][Par.29][IP(s) : 35,10,24,31] - [Par.25][Par.29][IP(s) : 24,26,28,18] -
IP.21. Skipping/ Avoiding (Pos.10) ***	IP. Tac.	[Par.13][Par.1][IP(s) : 21,35,2,39] -
IP.14. Spheroidality - Curvature - Angle (Pos.14) ***	IP. Tac.	[Par.13][Par.23][IP(s) : 2,14,30,40] - [Par.23][Par.13][IP(s) : 2,14,30,40] -

Inventive Principles (IP) selected for Recommended Solution:

To develop a Specific Solution based on the contradictions provided in Table V, where S1: PLASTIC CUP interacts with S2: CUSTOMERS, 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 PLASTIC CUP 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: (-) 23. Loss of substance and Attenuate or Preserve: (-) 25. Loss of Time

IP.15. Dynamics - strategic type (1)

a. Allow (or design) the characteristics of PLASTIC CUP*, external environment, or process to change to an optimal, or to find an optimal, operating condition.

b. Divide PLASTIC CUP* into parts that are capable of relative movement between each other.

c. If PLASTIC CUP* (or process) is rigid or inflexible, make it flexible or adaptive.

d. To enhance the dynamics of PLASTIC CUP* or the process, use feature(s) or object(s) available in the nearby environment.

IP.18. Mechanical Vibrations/ Energy Variations - tactical type (2)

a. Move PLASTIC CUP* by cycles with energies that activate it.

b. Cause PLASTIC CUP* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of PLASTIC CUP*. If necessary, decrease frequency.

c. Use vibration-generating fields in, or for, PLASTIC CUP* instead of mechanical vibration generators. Combine sources of oscillations.

d. Apply alternation of PLASTIC CUP* or its parts or functions.

IP.35. Transformation / Parameter Changes - strategic type (3)

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.

IP.10. Preliminary Action - strategic type (4)

a. Perform the required change in, or for, PLASTIC CUP*, before it is needed (either fully or partially).

b. Pre-arrange PLASTIC CUP* and other objects, if necessary, in such a way that they can come into action from the most convenient place and without losing time for their delivery.

N°2 Improve: (+) 1. Heaviness of moving object and Attenuate or Preserve: (-) 29. Fulfillment of desired outcome

IP.28. Mechanics Substitution - strategic type (5)

a. Replace a direct or manual action in, or for, PLASTIC CUP*, with a mechanical action or a tool.

b. Replace a mechanical means in, or for, PLASTIC CUP*, 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 gto improve action of PLASTIC CUP*.

d. Change from static fields in, or for, PLASTIC CUP* 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, PLASTIC CUP*.

IP.35. Transformation / Parameter Changes - strategic type (6)

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
IP.26. Copying/ Replicating - strategic type (7)
a. Instead of using PLASTIC CUP*, 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 PLASTIC CUP*, 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.18. Mechanical Vibrations/ Energy Variations - tactical type (8)
a. Move PLASTIC CUP* by cycles with energies that activate it.
b. Cause PLASTIC CUP* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of PLASTIC CUP*. If necessary, decrease frequency.
c. Use vibration-generating fields in, or for, PLASTIC CUP* instead of mechanical vibration generators. Combine sources of oscillations.
d. Apply alternation of PLASTIC CUP* or its parts or functions.

N°3 Improve: (+) 1. Heaviness of moving object and Attenuate or Preserve: (-) 25. Loss of Time
IP.10. Preliminary Action - strategic type (9)
a. Perform the required change in, or for, PLASTIC CUP*, before it is needed (either fully or partially).
b. Pre-arrange PLASTIC CUP* and other objects, if necessary, in such a way that they can come into action from the most convenient place and without losing time for their delivery.
IP.35. Transformation / Parameter Changes - strategic type (10)
a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
IP.20. Continuity of Useful Action - operative type (11)
a. Make sure work is executed on continuously with PLASTIC CUP*.
b. Make all parts of PLASTIC CUP* work at full load, all the time.
c. Eliminate all idle or intermittent actions or work of PLASTIC CUP*.
IP.28. Mechanics Substitution - strategic type (12)
a. Replace a direct or manual action in, or for, PLASTIC CUP*, with a mechanical action or a tool.
b. Replace a mechanical means in, or for, PLASTIC CUP*, 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 gto improve action of PLASTIC CUP*.
d. Change from static fields in, or for, PLASTIC CUP* 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, PLASTIC CUP*.

N°4 Improve: (-) 29. Fulfillment of desired outcome and Attenuate or Preserve: (-) 25. Loss of Time

IP.32. Perception/ Appearance/ Color Changes - strategic type (13)

a. Change how is perceived, the appearance or shape of PLASTIC CUP* in relation to the object S2 with which it interacts.

b. Change the color, or appearance, of PLASTIC CUP* or its external environment.

c. Change the transparency of PLASTIC CUP* or its external environment.

IP.26. Copying/ Replicating - strategic type (14)

a. Instead of using PLASTIC CUP*, 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 PLASTIC CUP*, 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.28. Mechanics Substitution - strategic type (15)

a. Replace a direct or manual action in, or for, PLASTIC CUP*, with a mechanical action or a tool.

b. Replace a mechanical means in, or for, PLASTIC CUP*, 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 gto improve action of PLASTIC CUP*.

d. Change from static fields in, or for, PLASTIC CUP* 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, PLASTIC CUP*.

IP.18. Mechanical Vibrations/ Energy Variations - tactical type (16)

a. Move PLASTIC CUP* by cycles with energies that activate it.

b. Cause PLASTIC CUP* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of PLASTIC CUP*. If necessary, decrease frequency.

c. Use vibration-generating fields in, or for, PLASTIC CUP* instead of mechanical vibration generators. Combine sources of oscillations.

d. Apply alternation of PLASTIC CUP* or its parts or functions.

N°5 Improve: (+) 1. Heaviness of moving object and Attenuate or Preserve: (-) 23. Loss of substance

IP.5. Merging/ Separating - operative type (17)

a. Bring PLASTIC CUP* closer or merge with other objects with similar or identical operations or functions.

b. Bring PLASTIC CUP* closer or merge with other objects with similar operations or functions for them to act together at the same time.

c. Merge different shapes or actions into PLASTIC CUP*.

d. If there are objects fused to PLASTIC CUP, and if necessary, apply a separation action.

IP.35. Transformation / Parameter Changes - strategic type (18)

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.

IP.3. Local Quality - strategic type (19)

a. Improve quality in a localized way, for parts, components, or conditions of PLASTIC CUP*.

b. Change the structure, action, or procedure of PLASTIC CUP* from uniform to non-uniform, or vice versa.

c. Change the external environment (or external influence) of PLASTIC CUP* from uniform to non-uniform, or vice versa.

d. Make each part of PLASTIC CUP* function in the conditions that are most suitablx for its operation.

e. Make each part of PLASTIC CUP* fulfill a different and useful function.

IP.31. Using/ Removing Unused Parts - operative type (20)

a. Take advantage of unused parts of PLASTIC CUP*.

b. Remove or do not use unnecessary parts of PLASTIC CUP*.

N°6 Improve: 13. Stability and Preserve: 38. Extent of automation/ autonomy

IP.1. Segmenting/ Integrating - strategic type (21)

a. Divide PLASTIC CUP* into existing and/or new parts, shapes, phases, states, or conditions.

b. Integrate different existing or new parts, forms, phases, states or conditions of PLASTIC CUP* in a single entity.

c. Make PLASTIC CUP* easy to disassemble or assemble.

d. Increase or reduce the degree of fragmentation or segmentation of PLASTIC CUP*.

IP.8. Anti-Weight/ Compensation - tactical type (22)

a. To compensate for the heaviness/lightness or incidence of PLASTIC CUP*, merge it with other objects or independent own parts that provide an effect to improve the current situation.

b. To compensate for the heaviness/lightness or incidence of PLASTIC CUP*, make it interact with the environment.

IP.35. Transformation / Parameter Changes - strategic type (23)

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.

N°7 Improve: 13. Stability and Preserve: 35. Adaptability or versatility

IP.35. Transformation / Parameter Changes - strategic type (24)

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.

IP.30. Simple Shapes/ Ways to Interact - tactical type (25)

a. Use flexible rods and ropes, or similar one-dimensional functionality, or shells and thin films, or similar two-dimensional functionality, for PLASTIC CUP*, instead of complex three-dimensional structures, in type and number of components and shapes.

b. Separate/isolate PLASTIC CUP* 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 PLASTIC CUP* 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.
IP.34. Discarding and Recovering - tactical type (26)
a. Make portions of PLASTIC CUP*, which have fulfilled their functions or are unnecessary, go away (discard by absorption, dissolving, evaporating, et**c.**).
b. Conversely, restore consumable parts of PLASTIC CUP* directly in operation.
IP.2. Taking out/ Adding - strategic type (27)
a. Separate an interfering part or a property from PLASTIC CUP*, or single out the only necessary part (or property) of PLASTIC CUP*. **b.** Add new parts or properties to PLASTIC CUP*.

N°8 Improve: 13. Stability and Preserve: 34. Ease of change, repair or maintain
IP.2. Taking out/ Adding - strategic type (28)
a. Separate an interfering part or a property from PLASTIC CUP*, or single out the only necessary part (or property) of PLASTIC CUP*. **b.** Add new parts or properties to PLASTIC CUP*.
IP.35. Transformation / Parameter Changes - strategic type (29)
a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
IP.10. Preliminary Action - strategic type (30)
a. Perform the required change in, or for, PLASTIC CUP*, before it is needed (either fully or partially).
b. Pre-arrange PLASTIC CUP* and other objects, if necessary, in such a way that they can come into action from the most convenient place and without losing time for their delivery.
IP.16. Partial or Excessive Actions - operative type (31)
a. If the objective of PLASTIC CUP* in its interaction with CUSTOMERS is difficult to fully achieve using a given solution, then use 'a little less' or 'a little more' of the same solution.

Relevant inventive principles from Table II not included in Recommended Solution
IP.24. Intermediary (Pos.(8) - tactical type (32)
a. for PLASTIC CUP*, use an intermediary carrier article or intermediary process.
b. Merge PLASTIC CUP* temporarily with another object (which can be easily removed or removed by itself).
IP.21. Skipping/ Avoiding (Pos.(10) - tactical type (33)
a. Make sure that with PLASTIC CUP*, 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 PLASTIC CUP*.
IP.14. Spheroidality - Curvature - Angle (Pos.(14) - tactical type (34)
a. For the interaction between PLASTIC CUP* and Object S2, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.
b. For the interaction between PLASTIC CUP* 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 PLASTIC CUP* 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, PLASTIC CUP*.
e. Go from linear to rotary motion, use centrifugal forces in, or for, PLASTIC CUP*.
f. If there is Spheroidality , curvature or angle, increase or reduce, as applicable, in, or for, PLASTIC CUP*.

TABLE VI. RESULTS OF SENSITIVITY ANALYSIS FOR THE EVALUATED OBJECT PLASTIC CUP
CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

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 (%)
#	1	23	25	29	13. Stability	95.17	100	96.38

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	1	23	25	29	13. Stability **(E)**	95.17	100	96.38
II.a	1	23	29	31	19. Use of energy by moving object	93.4	100	95.05
III.a	1	25	29	31	19. Use of energy by moving object	93.4	100	95.05
IV.a	1	17	23	29	39. Productivity	93.13	100	94.85
V.a	1	12	25	29	13. Stability	91.54	100	93.66

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	1	23	29	31	13. Stability	96.45	67.42	89.19	-
II.b	1	23	25	29	13. Stability **(E)**	95.17	100	96.38	I.a

III.b	1	12	23	29	13. Stability	95.17	21.8	76.83	-
IV.b	1	12	29	31	19. Use of energy by moving object	93.74	12.96	73.55	-
V.b	1	23	29	31	19. Use of energy by moving object	93.4	100	95.05	II.a

TABLE VII ESSENTIAL CONTRADICTIONS MATRIX FOR NEEDS TO SATISFY (NS) FOR THE SAME UNDESIRABLE EFFECTS EVALUATED OF: PLASTIC CUP

CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

Evaluated need to satisfy in this report: **13. Stability**

UDEs: (+) 1. Heaviness of moving object// (-) 23. Loss of substance// (-) 25. Loss of Time// (-) 29. Fulfillment of desired outcome

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
13. Stability	(-) 23. Loss of substance	(-) 25. Loss of Time	[15,18,35,10]	95.17	100	96.38
39. Productivity	(-) 23. Loss of substance	(-) 25. Loss of Time	[15,18,35,10]	88.99	100	91.74
19. Use of energy by moving object	(-) 23. Loss of substance	(-) 25. Loss of Time	[15,18,35,10]	81.74	100	86.31
35. Adaptability or versatility	(-) 23. Loss of substance	(-) 25. Loss of Time	[15,18,35,10]	72.8	100	79.6
32. Ease of achieving desired outcome	(-) 23. Loss of substance	(-) 25. Loss of Time	[15,18,35,10]	68	100	76
34. Ease of change, repair or maintain	(+) 1. Heaviness of moving object	(-) 25. Loss of Time	[10,35,20,28]	83.44	26.55	69.21
27. Reliability	(+) 1. Heaviness of moving object	(-) 25. Loss of Time	[10,35,20,28]	77.36	26.55	64.66
33. Ease of operation	(+) 1. Heaviness of moving object	(-) 25. Loss of Time	[10,35,20,28]	70.57	26.55	59.57
15. Duration of action of moving object	(+) 1. Heaviness of moving object	(-) 25. Loss of Time	[10,35,20,28]	62.91	26.55	53.82

38. Extent of automation/ autonomy	(+) 1. Heaviness of moving object	(-) 29. Fulfillment of desired outcome	[28,35,26,18]	42.03	13.26	34.83

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: 13. Stability.

TABLE VIII. ORDER OF INCIDENCE OF INVENTIVE PRINCIPLES (POS.n)
CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand
Participation analysis of inventive principles in TABLE II SPECIFIC CONTRADICTION MATRIX.
Evaluated parameters for Object PLASTIC CUP:
Par. UDEs:
(+) 1. Heaviness of moving object
(-) 23. Loss of substance
(-) 25. Loss of Time
(-) 29. Fulfillment of desired outcome
Par. NS: (+) 13. Stability

***: 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.23][Par.1][IP(s) : 35,6,23,40] - [Par.25][Par.1][IP(s) : 10,20,37,35] - [Par.13][Par.1][IP(s) : 21,35,2,39] - [Par.1][Par.23][IP(s) : 5,35,3,31] - [Par.25][Par.23][IP(s) : 35,18,10,39] - [Par.29] [Par.23][IP(s) : 35,31,10,24] - [Par.1][Par.25][IP(s) : 10,35,20,28] - [Par.23][Par.25][IP(s) : 15,18,35,10] - [Par.13][Par.25][IP(s) : 35,27,0,0] - [Par.1][Par.29][IP(s) : 28,35,26,18] - [Par.23][Par.29][IP(s) : 35,10,24,31] - [Par.1][Par.13][IP(s) : 1,35,19,39] - [Par.25] [Par.13][IP(s) : 35,3,22,5] -

IP.10. Preliminary Action (Pos.2)	IP. Str.	II / III / IV	[Par.25][Par.1][IP(s) : 10,20,37,35] - [Par.25][Par.23][IP(s) : 35,18,10,39] - [Par.29][Par.23][IP(s) : 35,31,10,24] - [Par.1][Par.25][IP(s) : 10,35,20,28] - [Par.23][Par.25][IP(s) : 15,18,35,10] - [Par.23][Par.29][IP(s) : 35,10,24,31] -
IP.28. Mechanics Substitution (Pos.3)	IP. Str.	II / III /	[Par.29][Par.1][IP(s) : 28,32,13,18] - [Par.1][Par.25][IP(s) : 10,35,20,28] - [Par.29][Par.25][IP(s) : 32,26,28,18] - [Par.1][Par.29][IP(s) : 28,35,26,18] - [Par.25][Par.29][IP(s) : 24,26,28,18] -
IP.2. Taking out/ Adding (Pos.4)	IP. Str.	II / IV	[Par.13][Par.1][IP(s) : 21,35,2,39] - [Par.13][Par.23][IP(s) : 2,14,30,40] - [Par.23][Par.13][IP(s) : 2,14,30,40] -
IP.18. Mechanical Vibrations/ Energy Variations (Pos.5)	IP. Tac.	II / III /	[Par.29][Par.1][IP(s) : 28,32,13,18] - [Par.25][Par.23][IP(s) : 35,18,10,39] - [Par.23][Par.25][IP(s) : 15,18,35,10] - [Par.29][Par.25][IP(s) : 32,26,28,18] - [Par.1][Par.29][IP(s) : 28,35,26,18] - [Par.25][Par.29][IP(s) : 24,26,28,18] - [Par.13][Par.29][IP(s) : 18,0,0,0] - [Par.29][Par.13][IP(s) : 30,18,0,0] -
IP.32. Perception/ Appearance/ Color Changes (Pos.6)	IP. Str.	II / III / IV	[Par.29][Par.1][IP(s) : 28,32,13,18] - [Par.29][Par.25][IP(s) : 32,26,28,18] -
IP.30. Simple Shapes/ Ways to Interact (Pos.7)	IP. Tac.	II / IV	[Par.13][Par.23][IP(s) : 2,14,30,40] - [Par.23][Par.13][IP(s) : 2,14,30,40] - [Par.29][Par.13][IP(s) : 30,18,0,0] -
IP.24. Intermediary (Pos.8) ***	IP. Tac.	II /	[Par.29][Par.23][IP(s) : 35,31,10,24] - [Par.23][Par.29][IP(s) : 35,10,24,31] - [Par.25][Par.29][IP(s) : 24,26,28,18] -
IP.5. Merging/ Separating (Pos.9)	**IP. Oper.**	II / III /	[Par.1][Par.23][IP(s) : 5,35,3,31] - [Par.25][Par.13][IP(s) : 35,3,22,5] -
IP.21. Skipping/ Avoiding (Pos.10) ***	IP. Tac.	II /	[Par.13][Par.1][IP(s) : 21,35,2,39] -
IP.15. Dynamics (Pos.11)	IP. Str.	II / III /	[Par.23][Par.25][IP(s) : 15,18,35,10] -
IP.1. Segmenting/ Integrating (Pos.12)	IP. Str.	II / IV	[Par.1][Par.13][IP(s) : 1,35,19,39] -
IP.26. Copying/ Replicating (Pos.13)	IP. Str.	II / III /	[Par.29][Par.25][IP(s) : 32,26,28,18] - [Par.1][Par.29][IP(s) : 28,35,26,18] - [Par.25][Par.29][IP(s) : 24,26,28,18] -
IP.14. Spheroidality - Curvature - Angle (Pos.14) ***	IP. Tac.	II /	[Par.13][Par.23][IP(s) : 2,14,30,40] - [Par.23][Par.13][IP(s) : 2,14,30,40] -

IP.20. Continuity of Useful Action (Pos.15)	**IP. Oper.**	II / III /	[Par.25][Par.1][IP(s) : 10,20,37,35] - [Par.1][Par.25][IP(s) : 10,35,20,28] -
IP.3. Local Quality (Pos.16)	IP. Str.	II / III / IV	[Par.1][Par.23][IP(s) : 5,35,3,31] - [Par.25][Par.13][IP(s) : 35,3,22,5] -
IP.31. Using/ Removing Unused Parts (Pos.17)	**IP. Oper.**	II / III /	[Par.1][Par.23][IP(s) : 5,35,3,31] - [Par.29][Par.23][IP(s) : 35,31,10,24] - [Par.23][Par.29][IP(s) : 35,10,24,31] -
IP.27. Cheap Short-Living Objects (Pos.18) ***	IP. Str.	II / IV	[Par.13][Par.25][IP(s) : 35,27,0,0] -
IP.6. Universality (Pos.19) ***	IP. Tac.	II /	[Par.23][Par.1][IP(s) : 35,6,23,40] -
IP.40. Composite Materials/ Conditions (Pos.20) ***	**IP. Oper.**	II / IV	[Par.23][Par.1][IP(s) : 35,6,23,40] - [Par.13][Par.23][IP(s) : 2,14,30,40] - [Par.23][Par.13][IP(s) : 2,14,30,40] -
IP.39. Inert Atmosphere / Environment (Pos.21) ***	**IP. Oper.**	II /	[Par.13][Par.1][IP(s) : 21,35,2,39] - [Par.25][Par.23][IP(s) : 35,18,10,39] - [Par.1][Par.13][IP(s) : 1,35,19,39] -
IP.37. Useful Perceptible Change (Pos.22) ***	**IP. Oper.**	II /	[Par.25][Par.1][IP(s) : 10,20,37,35] -
IP.23. Feedback (Pos.23) ***	**IP. Oper.**	II / IV	[Par.23][Par.1][IP(s) : 35,6,23,40] -
IP.22. Convert harm in benefit (Pos.24) ***	IP. Str.	II /	[Par.25][Par.13][IP(s) : 35,3,22,5] -
IP.19. Time-Varying Action/ Periodic or Pulsating (Pos.25) ***	IP. Str.	II / IV	[Par.1][Par.13][IP(s) : 1,35,19,39] -
IP.13. Reverse or Indirect Action (Pos.26) ***	IP. Str.	II / IV	[Par.29][Par.1][IP(s) : 28,32,13,18] -

TABLE IX. RECOMMENDED SOLUTION ACCORDING TO THE MOST RELEVANT CONTRADICTIONS

IDENTIFIED FOR THE EVALUATED OBJECT: PLASTIC CUP
CHALLENGE: Improve Hot coffee service in plastic cup affected by burning customers' hand

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 PLASTIC CUP when it interacts with CUSTOMERS and there is an affected function: Hot coffee service in plastic cup affected by burning customers' hand, in a specific space and time. PLASTIC CUP 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 PLASTIC CUP with an asterisk. Do not read the name of the evaluated object literally; associate it with a possible solution for PLASTIC CUP*.

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 PLASTIC CUP, 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 PLASTIC CUP
NEED TO SATISFY: 13. Stability
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: (-) 23. Loss of substance
TO IMPROVE (UDE): PLASTIC CUP has Less Loss of substance or relevant value, interacting with S2

Parameter to attenuate or preserve: (-) 25. Loss of Time

TO ATTENUATE OR PRESERVE (UDE): PLASTIC CUP has Less Loss of time or causes a bottleneck interacting with S2

Inventive principles IP(s) : [15,18,35,10]

15. Dynamics, Str. IP (Pos.11):

a. Allow (or design) the characteristics of PLASTIC CUP*, external environment, or process to change to an optimal, or to find an optimal, operating condition.

b. Divide PLASTIC CUP* into parts that are capable of relative movement between each other.

c. If PLASTIC CUP* (or process) is rigid or inflexible, make it flexible or adaptive.

d. To enhance the dynamics of PLASTIC CUP* or the process, use feature(s) or object(s) available in the nearby environment.

Separation principle for PLASTIC CUP* : Separation in time

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

18. Mechanical Vibrations/ Energy Variations, Tac. IP (Pos.5):

a. Move PLASTIC CUP* by cycles with energies that activate it

b. Cause PLASTIC CUP* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of PLASTIC CUP*. If necessary, decrease frequency.

c. Use vibration-generating fields in, or for, PLASTIC CUP* instead of mechanical vibration generators. Combine sources of oscillations (e.g., ultrasonic, and electromagnetic).

d. Apply alternation of PLASTIC CUP* or its functions.

Separation principle for PLASTIC CUP* : Separation in time

Solution strategy for PLASTIC CUP* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

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

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.

Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative

Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

10. Preliminary Action, Str. IP (Pos.2):

a. Perform the required change in, or for, PLASTIC CUP*, before it is needed (either fully or partially).

b. Pre-arrange PLASTIC CUP* and other objects, if necessary, in such a way that they can come into action from the most convenient place and without losing time for their delivery.

Separation principle for PLASTIC CUP* : Separation in time

Solution strategy for PLASTIC CUP* : Improving attributes; Improving performance

COMPLEMENTARY CONTRADICTION 1

Contradiction order wt.2

Parameter to improve: (+) 1. Heaviness of moving object

TO IMPROVE (UDE): PLASTIC CUP has More Heaviness, value, cost, or restriction, whether physical or figurative interacting with S2

Parameter to attenuate or preserve: (-) 29. Fulfillment of desired outcome

TO ATTENUATE OR PRESERVE (UDE): PLASTIC CUP has Less Achievement of desired outcome interacting with S2

Inventive principles IP(s) : [28,35,26,18]

28. Mechanics Substitution, Str. IP (Pos.3):

a. Replace a direct or manual action in, or for, PLASTIC CUP*, with a mechanical action or a tool.

b. Replace a mechanical means in, or for, PLASTIC CUP*, 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 PLASTIC CUP*.

d. Change from static fields in, or for, PLASTIC CUP* 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, PLASTIC CUP*.

Separation principle for PLASTIC CUP* : Separation by condition

Solution strategy for PLASTIC CUP* : Improving attributes

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

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.

Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative

Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

26. Copying/ Replicating, Str. IP (Pos.13):

a. Instead of using PLASTIC CUP*, 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 PLASTIC CUP*, 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 PLASTIC CUP* : Separation in space

Solution strategy for PLASTIC CUP* : Improving if a solution has not yet emerged

18. Mechanical Vibrations/ Energy Variations, Tac. IP (Pos.5):

a. Move PLASTIC CUP* by cycles with energies that activate it

b. Cause PLASTIC CUP* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the resonant frequency of PLASTIC CUP*. If necessary, decrease frequency.

c. Use vibration-generating fields in, or for, PLASTIC CUP* instead of mechanical vibration generators. Combine sources of oscillations (e.g., ultrasonic, and electromagnetic).

d. Apply alternation of PLASTIC CUP* or its functions.

Separation principle for PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

COMPLEMENTARY CONTRADICTION 2
Contradiction order wt.3

Parameter to improve: (+) 1. Heaviness of moving object
TO IMPROVE (UDE): PLASTIC CUP has More Heaviness, value, cost, or restriction, whether physical or figurative interacting with S2
Parameter to attenuate or preserve: (-) 25. Loss of Time
TO ATTENUATE OR PRESERVE (UDE): PLASTIC CUP has Less Loss of time or causes a bottleneck interacting with S2
Inventive principles IP(s) : [10,35,20,28]
10. Preliminary Action, Str. IP (Pos.2):
a. Perform the required change in, or for, PLASTIC CUP*, before it is needed (either fully or partially).
b. Pre-arrange PLASTIC CUP* and other objects, if necessary, in such a way that they can come into action from the most convenient place and without losing time for their delivery.
Separation principle for PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving attributes; Improving performance
35. Transformation/ Parameter Changes, Str. IP (Pos.1):
a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative
Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)
20. Continuity of Useful Action, Oper. IP (Pos.15):
a. Make sure work is executed on continuously with PLASTIC CUP*.
b. Make all parts of PLASTIC CUP* work at full load, all the time.
c. Eliminate all idle or intermittent actions or work of PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving if a solution has not yet emerged
28. Mechanics Substitution, Str. IP (Pos.3):
a. Replace a direct or manual action in, or for, PLASTIC CUP*, with a mechanical action or a tool.
b. Replace a mechanical means in, or for, PLASTIC CUP*, 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 PLASTIC CUP*.
d. Change from static fields in, or for, PLASTIC CUP* 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, PLASTIC CUP*.

Separation principle for PLASTIC CUP* : Separation by condition
Solution strategy for PLASTIC CUP* : Improving attributes

COMPLEMENTARY CONTRADICTION 3
Contradiction order wt.6

Parameter to improve: (-) 29. Fulfillment of desired outcome
TO IMPROVE (UDE): PLASTIC CUP has Less Achievement of desired outcome interacting with S2
Parameter to attenuate or preserve: (-) 25. Loss of Time
TO ATTENUATE OR PRESERVE (UDE): PLASTIC CUP has Less Loss of time or causes a bottleneck interacting with S2
Inventive principles IP(s) : [32,26,28,18]
32. Perception/ Appearance/ Color Changes, Str. IP (Pos.6):
a. Change how is perceived, the appearance or shape of PLASTIC CUP* in relation to the object (S2) with which it interacts.
b. Change the color, or appearance, of PLASTIC CUP* or its external environment.
c. Change the transparency of PLASTIC CUP* or its external environment.
Separation principle for PLASTIC CUP* : Separation by condition
Solution strategy for PLASTIC CUP* : Improving if a solution has not yet emerged
26. Copying/ Replicating, Str. IP (Pos.13):
a. Instead of using PLASTIC CUP*, 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 PLASTIC CUP*, 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 PLASTIC CUP* : Separation in space
Solution strategy for PLASTIC CUP* : Improving if a solution has not yet emerged
28. Mechanics Substitution, Str. IP (Pos.3):
a. Replace a direct or manual action in, or for, PLASTIC CUP*, with a mechanical action or a tool.
b. Replace a mechanical means in, or for, PLASTIC CUP*, 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 PLASTIC CUP*.
d. Change from static fields in, or for, PLASTIC CUP* 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, PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation by condition
Solution strategy for PLASTIC CUP* : Improving attributes
18. Mechanical Vibrations/ Energy Variations, Tac. IP (Pos.5):
a. Move PLASTIC CUP* by cycles with energies that activate it
b. Cause PLASTIC CUP* to oscillate or vibrate. Increase its frequency (even up to the ultrasonic). Use the

resonant frequency of PLASTIC CUP*. If necessary, decrease frequency.
c. Use vibration-generating fields in, or for, PLASTIC CUP* instead of mechanical vibration generators. Combine sources of oscillations (e.g., ultrasonic, and electromagnetic).
d. Apply alternation of PLASTIC CUP* or its functions.
Separation principle for PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

COMPLEMENTARY CONTRADICTION 4
Contradiction order wt.10

Parameter to improve: (+) 1. Heaviness of moving object
TO IMPROVE (UDE): PLASTIC CUP has More Heaviness, value, cost, or restriction, whether physical or figurative interacting with S2
Parameter to attenuate or preserve: (-) 23. Loss of substance
TO ATTENUATE OR PRESERVE (UDE): PLASTIC CUP has Less Loss of substance or relevant value, interacting with S2
Inventive principles IP(s) : [5,35,3,31]
5. Merging/ Separating, Str. IP (Pos.9):
a. Bring PLASTIC CUP* closer or merge with other objects with similar or identical operations or functions.
b. Bring PLASTIC CUP* closer or merge with other objects with similar operations or functions so that they can act together at the same time.
c. If there are objects fused to PLASTIC CUP*, and if necessary, apply a separation action.
d. If objects are merged, and if necessary, apply a separation action.
Separation principle for PLASTIC CUP* : Integration in supersystem
Solution strategy for PLASTIC CUP* : Improving attributes
35. Transformation/ Parameter Changes, Str. IP (Pos.1):
a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative
Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)
3. Local quality, Str. IP (Pos.16):
a. Improve quality in a localized way, for parts, components, or conditions of PLASTIC CUP*.
b. Change the structure, action, or procedure of PLASTIC CUP* from uniform to non-uniform, or vice versa.
c. Change the external environment (or external influence) of PLASTIC CUP* from uniform to non-uniform, or vice versa.
d. Make each part of PLASTIC CUP* function in the conditions that are most suitablx for its operation.
e. Make each part of PLASTIC CUP* fulfill a different and useful function.
Separation principle for PLASTIC CUP* : Separation in space

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

31. Using/ Removing Unused Parts, Oper. IP (Pos.17):

a. Take advantage of unused parts of PLASTIC CUP*.

b. Remove or do not use unnecessary parts of PLASTIC CUP*.

(e.g., make an object porous or add porous elements – inserts, coatings, etc. If an object is already porous, use the pores to introduce a useful substance or function).

Separation principle for PLASTIC CUP* : Separation by condition

Solution strategy for PLASTIC CUP* : Improving if a solution has not yet emerged

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 13. Stability

MEJORAR > PLASTIC CUP tiene More Desired stability to interact with S2

Parameter to preserve 38. Extent of automation/ autonomy

PRESERVAR > PLASTIC CUP tiene más efecto deseable por párametro 38. Extent of automation/ autonomy

Inventive principles IP(s) : [1,8,35,0]

1. Segmenting/ Integrating, Str. IP (Pos.12):

a. Divide PLASTIC CUP* 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 PLASTIC CUP* into a single entity..

c. Make PLASTIC CUP* easy to disassemble or assemble.

d. Increase or reduce the degree of fragmentation or segmentation of PLASTIC CUP*.

Separation principle for PLASTIC CUP* : Separation in space / Separation in subsystem

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

8. Anti-weight/ Compensation, Tac. IP (Pos.):

a. To compensate for the heaviness/lightness or incidence of PLASTIC CUP*, merge it with other objects or independent own parts that provide an effect to improve the current situation.

b. To compensate for the heaviness/lightness or incidence of PLASTIC CUP*, make it interact with the environment.

For example, compensate for the heaviness of PLASTIC CUP* subject to a gravitational field, or exposed to a magnetic field, or subject to an economic value or price, or subject to a chemical bond, or subject to intellectual rigidity, a paradigm, or prejudices.

Separation principle for PLASTIC CUP* : Separation alternative

Solution strategy for PLASTIC CUP* : Improving attributes

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

a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative
Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

CONTRADICTION BETWEEN NEEDS TO SATISFY Nº 2
Parameter to improve 13. Stability
MEJORAR > PLASTIC CUP tiene More Desired stability to interact with S2
Parameter to preserve 35. Adaptability or versatility
PRESERVAR > PLASTIC CUP tiene más efecto deseable por párametro 35. Adaptability or versatility
Inventive principles IP(s) : [35,30,34,2]
35. Transformation/ Parameter Changes, Str. IP (Pos.1):
a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative
Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)
30. Simple Shapes/ Ways to Interact, Tac. IP (Pos.7):
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 PLASTIC CUP*, instead of complex three-dimensional structures, in type and number of components and shapes.
b. Separate/isolate PLASTIC CUP* 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 PLASTIC CUP* 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 PLASTIC CUP* : Separation in space
Solution strategy for PLASTIC CUP* : Improving attributes
34. Discarding and Recovering, Tac. IP (Pos.):
a. Make portions of PLASTIC CUP* , which have fulfilled their functions or are unnecessary, go away (discard by absorption, dissolving, evaporating, etc.).
b. Conversely, restore consumable parts of PLASTIC CUP* directly in operation.
Separation principle for PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving if a solution has not yet emerged
2. Taking Out/ Adding, Str. IP (Pos.4):
a. Separate an interfering part or a property from PLASTIC CUP*, or single out the only necessary part (or property) of PLASTIC CUP*.
b. Add new parts or properties to PLASTIC CUP*.

Separation principle for PLASTIC CUP* : Separation in space
Solution strategy for PLASTIC CUP* : Improving attributes

CONTRADICTION BETWEEN NEEDS TO SATISFY N° 3
Parameter to improve 13. Stability
MEJORAR > PLASTIC CUP tiene More Desired stability to interact with S2
Parameter to preserve 34. Ease of change, repair or maintain
PRESERVAR > PLASTIC CUP tiene más efecto deseable por párametro 34. Ease of change, repair or maintain
Inventive principles IP(s) : [2,35,10,16]
2. Taking Out/ Adding, Str. IP (Pos.4):
a. Separate an interfering part or a property from PLASTIC CUP*, or single out the only necessary part (or property) of PLASTIC CUP*.
b. Add new parts or properties to PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation in space
Solution strategy for PLASTIC CUP* : Improving attributes
35. Transformation/ Parameter Changes, Str. IP (Pos.1):
a. Change PLASTIC CUP*'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 PLASTIC CUP* 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 PLASTIC CUP*.
Separation principle for PLASTIC CUP* : Separation by condition / Separation alternative
Solution strategy for PLASTIC CUP* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)
10. Preliminary Action, Str. IP (Pos.2):
a. Perform the required change in, or for, PLASTIC CUP*, before it is needed (either fully or partially).
b. Pre-arrange PLASTIC CUP* and other objects, if necessary, in such a way that they can come into action from the most convenient place and without losing time for their delivery.
Separation principle for PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving attributes; Improving performance
16. Partial or Excessive Actions, Oper. IP (Pos.):
a. If the goal of PLASTIC CUP* 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 PLASTIC CUP* : Separation in time
Solution strategy for PLASTIC CUP* : Improving performance

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

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