

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

**INNOVATION CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts**

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

Web site: [www.aatrizinventor.com](http://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:** Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

**PHYSICAL VARIABLE OR CHARACTERISTIC:** Less Extraction certainty

**S1 OBJECT:** LOCKING PIN Type: Moving

**S2 OBJECT:** MALE-FEMALE PARTS OF CLOSING MECHANISM Type: Stationary

**DESIRED ACTION VERB:** Improve

**INNOVATION CHALLENGE:**

**CHALLENGE:** Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

**DESIRED GOAL:** More Extraction certainty

**EVALUATED OBJECT:** LOCKING PIN

**NEED TO SATISFY > 34. Ease of change, repair or maintain**

**SELECTED INNOVATION PARAMETERS TO EVALUATE:**

**A. UNDESIRABLE EFFECTS CAUSES OF DISSATISFACTION (UDEs)**

There are More difficulty to Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts because:

LOCKING PIN Has More Own length or relative distance, whether physical or figurative interacting with S2

LOCKING PIN Has Less Speed or rate of change interacting with S2

LOCKING PIN Has Less Strength or resistance interacting with S2

LOCKING PIN Has Less Adaptability or versatility to interaction variability of S2

There are undesirable effects that cause dissatisfaction because:

There is Less Extraction certainty

**B. DESIRED EFFECT FOR NEED TO SATISFY**

There is More ease to Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts because:

LOCKING PIN Has More Desired ease of change, repair or maintenance to interact with S2

There is desirable effect for need to satisfy because:

There is More Extraction certainty

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

**CHALLENGE:** Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

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.

<b>Parameters to evaluate(s)</b>	<b>It is understood as LOCKING PIN has:</b>
<b>Parámetros of undesirable effects (UDE):</b>	<b>Undesirable effects causes of dissatisfaction:</b>
(+) 3. Length of moving object	More Own length or relative distance, whether physical or figurative interacting with S2
(-) 9. Speed	Less Speed or rate of change interacting with S2
(-)14. Strength / Resistance	Less Strength or resistance interacting with S2
(-) 35. Adaptability or versatility	Less Adaptability or versatility to interaction variability of S2
<b>Desirable parameter (DE):</b>	<b>Desirable Effect for Need to satisfy:</b>
(+) 34. Ease of change, repair or maintain	More Desired ease of change, repair or maintenance to interact with S2
<b>TRIZ undesirables parameters for sensitivity analysis</b>	<b>It is understood as LOCKING PIN has:</b>
(+) 5. Area of moving object	More Own area or two-dimensional scope interacting with S2
(-) 10. Force/ Intensity	Less Force or impulse interacting with S2
(-) 12. Shape / composition / configuration	Less Appropriate shape, composition, or configuration interacting with S2
n/a	

n/a	
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## EVALUTION RESULTS TABLES

**TABLE II. SPECIFIC CONTRADICTION MATRIX FOR UNDESIRABLE EFFECTS AND NEED TO SATISFY. FOR EVALUATED OBJECT: LOCKING PIN AND NEED TO BE SATISFIED > 34. Ease of change, repair or maintain**

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

(\*) Preferred parameters: Improve 14. Strength / Resistance & Attenuate or preserve 3. Length of moving object.

Contradictions/ E.C: Essential, Compl.: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 PREF.	(-) Par.9	(-) Par.14	(-) Par.35	(+) Par.34	Sum wt
(+) 3. Length of moving object	wt		wt.7	<b>wt.4 Top 5</b>	<b>wt.2 Top 5</b>	wt.10	53%
	IP(s)	0,0,0,0	13,4,8,0	8,35,29,34	14,15,1,16	1,28,10,0	
(-) 9. Speed	wt	<b>wt.3 Compl.</b>		wt.8	wt.16	wt.14	42%
	IP(s)	13,14,8,0	0,0,0,0	8,3,26,14	15,10,26,0	34,2,28,27	
(-) 14. Strength / Resistance PREF.	wt	<b>wt.1 E.C.</b>	<b>wt.5 Compl.</b>		<b>wt.17 Compl.</b>	<b>wt.15 Compl.</b>	95%
	IP(s)	1,15,8,35	8,13,26,14	0,0,0,0	15,3,32,0	27,11,3,0	
(-) 35. Adaptability or versatility	wt	<b>wt.9 Compl.</b>	wt.6	wt.20		wt.12	35%
	IP(s)	35,1,29,2	35,10,14,0	35,3,32,6	0,0,0,0	1,16,7,4	
(+) 34. Ease of change, repair or maintain	wt	<b>wt.18 Compl.</b>	wt.19	wt.11	wt.12		28%
	IP(s)	1,28,10,25	34,9,0,0	11,1,2,9	7,1,4,16	0,0,0,0	
Sum wt		100%	39%	38%	38%	36%	

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: LOCKING PIN

#### NEED TO SATISFY > 34. Ease of change, repair or maintain

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

Table II Selection: Essential Contradiction wt.1 y Complementary contradictions with preferred parameters (*) wt.3/wt.5/wt.9/wt.15							
Parameter to improve	Parameter to attenuate or preserve	Contradict.	Wt.n	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
(-) 14. Strength / Resistance	(+) 3. Length of moving object	Essential	wt.1	<b>1 Es.</b>	<b>15 Es.</b>	<b>8 Es.</b>	<b>35 Es.</b>
(-) 9. Speed	(+) 3. Length of moving object	Compl. 1	wt.3	13	14	<b>8 Es.</b>	0
(-) 14. Strength / Resistance	(-) 9. Speed	Compl. 2	wt.5	<b>8 Es.</b>	13	26	14
(-) 35. Adaptability or versatility	(+) 3. Length of moving object	Compl. 3	wt.9	<b>35 Es.</b>	<b>1 Es.</b>	29	2
(-) 14. Strength / Resistance	(+) 34. Ease of change, repair or maintain	Compl. 4	wt.15	27	11	3	0

#### Inventive Principles (IP) selected for the Base Solution

- IP.1. Segmenting/ Integrating - strategic type
- IP.15. Dynamics - strategic type
- IP.8. Anti-Weight/ Compensation - tactical type
- IP.35. Transformation / Parameter Changes - strategic type
- IP.13. Reverse or Indirect Action - strategic type
- IP.14. Spheroidality - Curvature - Angle - tactical type
- IP.26. Copying/ Replicating - strategic type
- IP.29. Controllable Soft Variables - tactical type
- IP.2. Taking out/ Adding - strategic type
- IP.27. Cheap Short-Living Objects - strategic type

IP.11. Beforehand Cushioning - tactical type

IP.3. Local Quality - strategic 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: LOCKING PIN, NEED TO BE SATISFY: 34. Ease of change, repair or maintain**

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
34. Ease of change, repair or maintain	33. Ease of operation	1	<b>12</b> nT2	26	15
34. Ease of change, repair or maintain	34. Ease of change, repair or maintain	0	0	0	0
34. Ease of change, repair or maintain	32. Ease of achieving desired outcome	1	35	11	10 nT3
34. Ease of change, repair or maintain	19. Use of energy by moving object	15	1	28 nT3	16 nT3
34. Ease of change, repair or maintain	39. Productivity	1	32 nT3	10 nT3	0
34. Ease of change, repair or maintain	27. Reliability	11	10 nT3	1	16 nT3
34. Ease of change, repair or maintain	38. Extent of automation/ autonomy	34 nT3	35	7 nT3	13
34. Ease of change, repair or maintain	35. Adaptability or versatility	7 nT3	1	4 nT3	16 nT3
34. Ease of change, repair or maintain	13. Stability	2	35	0	0

34. Ease of change, repair or maintain	15. Duration of action of moving object	11	29	28 nT3	27
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**Inventive Principles (IP) selected for the Solution of relevant Contradictions between Needs to Satisfy**

IP.1. Segmenting/ Integrating - strategic tpe

IP.12. Equipotentiality - tactical type

IP.26. Copying/ Replicating - strategic tpe

IP.15. Dynamics - strategic tpe

97.59 % 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 LOCKING PIN.**

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 LOCKING PIN**

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

Evaluated need to satisfy in this report: **34. Ease of change, repair or maintain**

UDEs: (+) 3. Length of moving object// (-) 9. Speed// (-)14. Strength / Resistance// (-) 35. Adaptability or versatility

Parameter to improve	Parameter to attenuate or preserve	Contradict.	Wt.n	IP. Ord.1	IP Ord 2	IP Ord 3	IP Ord 4
(-) 14. Strength / Resistance	(+) 3. Length of moving object	Essential	wt.1	<b>1 Es.</b>	<b>15 Es.</b>	<b>8 Es.</b>	<b>35 Es.</b>

(-) 9. Speed	(+) 3. Length of moving object	Compl. 1	wt.3	13	14	8 Es.	0
(-) 14. Strength / Resistance	(-) 9. Speed	Compl. 2	wt.5	8 Es.	13	26	14
(-) 35. Adaptability or versatility	(+) 3. Length of moving object	Compl. 3	wt.9	35 Es.	1 Es.	29	2
(-) 14. Strength / Resistance	(+) 34. Ease of change, repair or maintain	Compl. 4	wt.15	27	11	3	0
34. Ease of change, repair or maintain	33. Ease of operation	NS.1	wns.1	1 Es.	12	26	15 Es.

### 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.34. Discarding and Recovering (Pos.6) ***	IP. Tac.	[Par.34][Par.9][ IP(s) : 34,9,0,0] - [Par.3][Par.14][ IP(s) : 8,35,29,34] - [Par.9][Par.34][ IP(s) : 34,2,28,27] -
IP.7. Nesting/ Dispersing (Pos.9) ***	IP. Tac.	[Par.34][Par.35][ IP(s) : 7,1,4,16] - [Par.35][Par.34][ IP(s) : 1,16,7,4] -
IP.10. Preliminary Action (Pos.12) ***	IP. Str.	[Par.34][Par.3][ IP(s) : 1,28,10,25] - [Par.35][Par.9][ IP(s) : 35,10,14,0] - [Par.9][Par.35][ IP(s) : 15,10,26,0] - [Par.3][Par.34][ IP(s) : 1,28,10,0] -

### Inventive Principles (IP) selected for Recommended Solution:

To develop a Specific Solution based on the contradictions provided in Table V, where S1: LOCKING PIN interacts with S2: MALE-FEMALE PARTS OF CLOSING MECHANISM, 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 LOCKING PIN 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: (-) 14. Strength / Resistance and Attenuate or Preserve: (+) 3. Length of moving object**

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

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

**IP.15. Dynamics - strategic type (2)**

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

**IP.8. Anti-Weight/ Compensation - tactical type (3)**

- a. To compensate for the heaviness/lightness or incidence of LOCKING PIN\*, 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 LOCKING PIN\*, make it interact with the environment.

**IP.35. Transformation / Parameter Changes - strategic type (4)**

- a. Change LOCKING PIN\*'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 LOCKING PIN\* 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 LOCKING PIN\*.

**N°2 Improve: (-) 9. Speed and Attenuate or Preserve: (+) 3. Length of moving object**

**IP.13. Reverse or Indirect Action - strategic type (5)**

- a. Inverse the applied action or apply an indirect action to perform the current function of LOCKING PIN\* to interact with object S2 It should be identified how LOCKING PIN\* currently performs an action with Object S2 and from there evaluate an inverse or indirect action.

- b. Make moving parts of LOCKING PIN\* (or the external environment) fixed, and fixed parts moving.
- c. Turn LOCKING PIN\* (or process) 'upside down', 'change the position', 'change the condition'.

**IP.14. Spheroidality - Curvature - Angle - tactical type (6)**

- a. For the interaction between LOCKING PIN\* and Object S2, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.
- b. For the interaction between LOCKING PIN\* 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 LOCKING PIN\* 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, LOCKING PIN\*.
- e. Go from linear to rotary motion, use centrifugal forces in, or for, LOCKING PIN\*.
- f. If there is Spheroidality, curvature or angle, increase or reduce, as applicable, in, or for, LOCKING PIN\*.

**IP.8. Anti-Weight/ Compensation - tactical type (7)**

- a. To compensate for the heaviness/lightness or incidence of LOCKING PIN\*, 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 LOCKING PIN\*, make it interact with the environment.

**N°3 Improve: (-) 14. Strength / Resistance and Attenuate or Preserve: (-) 9. Speed**

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

- a. To compensate for the heaviness/lightness or incidence of LOCKING PIN\*, 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 LOCKING PIN\*, make it interact with the environment.

**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 LOCKING PIN\* to interact with object S2 It should be identified how LOCKING PIN\* currently performs an action with Object S2 and from there evaluate an inverse or indirect action.
- b. Make moving parts of LOCKING PIN\* (or the external environment) fixed, and fixed parts moving.
- c. Turn LOCKING PIN\* (or process) 'upside down', 'change the position', 'change the condition'.

**IP.26. Copying/ Replicating - strategic type (10)**

- a. Instead of using LOCKING PIN\*, 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 LOCKING PIN\*, 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.14. Spheroidality - Curvature - Angle - tactical type (11)**

- a. For the interaction between LOCKING PIN\* and Object S2, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.
- b. For the interaction between LOCKING PIN\* 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 LOCKING PIN\* 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, LOCKING PIN\*.
- e. Go from linear to rotary motion, use centrifugal forces in, or for, LOCKING PIN\*.

f. If there is Spheroidality , curvature or angle, increase or reduce, as applicable, in, or for, LOCKING PIN\*.

**N°4 Improve: (-) 35. Adaptability or versatility and Attenuate or Preserve: (+) 3. Length of moving object**

**IP.35. Transformation / Parameter Changes - strategic type** (12)

- a. Change LOCKING PIN\*'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 LOCKING PIN\* 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 LOCKING PIN\*.

**IP.1. Segmenting/ Integrating - strategic type** (13)

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

**IP.29. Controllable Soft Variables - tactical type** (14)

- a. Use external, controllable soft variables (manual, physical, mechanical, pneumatic, hydraulic, electrical, magnetic, electromagnetic, digital, chemical, biological, social, psychological, physiological , etc.) to interact with LOCKING PIN\* facilitating goal fulfillment of the function performed with Object S2.
- b. Make easier LOCKING PIN\* interact with Object S2 using internal, controllable soft variables (manual, physical, mechanical, pneumatic, hydraulic, electrical, magnetic, electromagnetic, digital, chemical, biological, social, psychological, physiological , etc.) available in S1 and / or S2, facilitating goal fulfillment.

**IP.2. Taking out/ Adding - strategic type** (15)

- a. Separate an interfering part or a property from LOCKING PIN\*, or single out the only necessary part (or property) of LOCKING PIN\*. b. Add new parts or properties to LOCKING PIN\*.

**N°5 Improve: (-) 14. Strength / Resistance and Attenuate or Preserve: (+) 34. Ease of change, repair or maintain**

**IP.27. Cheap Short-Living Objects - strategic type** (16)

- a. Replace or divide (either fully or partially) LOCKING PIN\* 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 LOCKING PIN\* (e.g., the degree of participation, complexity, or lifetime), with no loss of functionality, to achieve the desired objective.

**IP.11. Beforehand Cushioning - tactical type** (17)

- a. Prepare emergency means, beforehand, to compensate for the relatively low reliability of LOCKING PIN\*.

**IP.3. Local Quality - strategic type** (18)

- a. Improve quality in a localized way, for parts, components, or conditions of LOCKING PIN\*.
- b. Change the structure, action, or procedure of LOCKING PIN\* from uniform to non-uniform, or vice versa.
- c. Change the external environment (or external influence) of LOCKING PIN\* from uniform to non-uniform, or vice versa.
- d. Make each part of LOCKING PIN\* function in the conditions that are most suitable for its operation.
- e. Make each part of LOCKING PIN\* fulfill a different and useful function.

**N°6 Improve: 34. Ease of change, repair or maintain and Preserve: 33. Ease of operation**

**IP.1. Segmenting/ Integrating - strategic type (19)**

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

**IP.12. Equipotentiality - tactical type (20)**

- a. In a potential field, limit position changes or energy variations of LOCKING PIN\*.
- b. Change operating conditions to eliminate the need to change the position or energy quality of LOCKING PIN\* in a potential field.

**IP.26. Copying/ Replicating - strategic type (21)**

- a. Instead of using LOCKING PIN\*, 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 LOCKING PIN\*, 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.15. Dynamics - strategic type (22)**

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

**N°7 Improve: and Preserve:**

**N°8 Improve: and Preserve:**

**Relevant inventive principles from Table II not included in Recommended Solution**

**IP.34. Discarding and Recovering (Pos.(6) - tactical type (23)**

- a. Make portions of LOCKING PIN\*, which have fulfilled their functions or are unnecessary, go away (discard by absorption, dissolving, evaporating, etc.).
- b. Conversely, restore consumable parts of LOCKING PIN\* directly in operation.

**(Pos.) (24)**

**IP.10. Preliminary Action (Pos.(12) - strategic type (25)**

- a. Perform the required change in, or for, LOCKING PIN\*, before it is needed (either fully or partially).
- b. Pre-arrange LOCKING PIN\* 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.

**TABLE VI. RESULTS OF SENSITIVITY ANALYSIS FOR THE EVALUATED OBJECT LOCKING PIN**

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

**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	9	14	35	34. Ease of change, repair or maintain	97.59	100	98.19

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	10	14	35	27. Reliability	98.17	100	98.62
II.a	3	10	12	14	33. Ease of operation	97.92	100	98.44
III.a	3	9	14	35	34. Ease of change, repair or maintain (E)	97.59	100	98.19
IV.a	9	12	14	35	34. Ease of change, repair or maintain	97.59	100	98.19
V.a	3	10	14	35	19. Use of energy by moving object	97.57	100	98.18

**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	5	9	10	35	34. Ease of change, repair or maintain	100	8.64	77.16	-

II.b	5	12	14	35	32. Ease of achieving desired outcome	98.22	41.27	83.99	-
III.b	3	10	14	35	27. Reliability	98.17	100	98.62	I.a
IV.b	3	9	10	35	27. Reliability	98.17	11.89	76.6	-
V.b	3	10	12	14	33. Ease of operation	97.92	100	98.44	II.a

**TABLE VII ESSENTIAL CONTRADICTIONS MATRIX FOR NEEDS TO SATISFY (NS) FOR THE SAME UNDESIRABLE EFFECTS EVALUATED OF: LOCKING PIN**

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

Evaluated need to satisfy in this report: **34. Ease of change, repair or maintain**

UDEs: (+) 3. Length of moving object// (-) 9. Speed// (-)14. Strength / Resistance// (-) 35. Adaptability or versatility

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
<b>34. Ease of change, repair or maintain</b>	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	97.59	100	98.19
27. Reliability	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	94.33	100	95.75
19. Use of energy by moving object	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	93.4	100	95.05
33. Ease of operation	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	92.76	100	94.57
39. Productivity	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	85.09	100	88.82
13. Stability	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	83.18	100	87.38
38. Extent of automation/ autonomy	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	79.05	100	84.28
35. Adaptability or versatility	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	77.62	100	83.22

15. Duration of action of moving object	(-)14. Strength / Resistance	(+) 3. Length of moving object	[1,15,8,35]	76.2	100	82.15
32. Ease of achieving desired outcome	(+) 32. Ease of achieving desired outcome	(-) 9. Speed	[35,13,8,1]	76.78	34.42	66.19

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: 34. Ease of change, repair or maintain.**

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

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

Participation analysis of inventive principles in TABLE II SPECIFIC CONTRADICTION MATRIX.

Evaluated parameters for Object LOCKING PIN:

Par. UDEs:

(+) 3. Length of moving object

(-) 9. Speed

(-)14. Strength / Resistance

(-) 35. Adaptability or versatility

Par. NS: (+) 34. Ease of change, repair or maintain

\*\*\*: 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.1. Segmenting/ Integrating (Pos.1)	IP. Str.	II / III / IV	[Par.14][Par.3][ IP(s) : 1,15,8,35] - [Par.35][Par.3][ IP(s) : 35,1,29,2] - [Par.34][Par.3][ IP(s) : 1,28,10,25] - [Par.34][Par.14][ IP(s) : 11,1,2,9] - [Par.3][Par.35][ IP(s) : 14,15,1,16] - [Par.34][Par.35][ IP(s) : 7,1,4,16] - [Par.3][Par.34][ IP(s) : 1,28,10,0] - [Par.35][Par.34][ IP(s) : 1,16,7,4] -

IP.35. Transformation / Parameter Changes (Pos.2)	IP. Str.	II / III / IV	[Par.14][Par.3][ IP(s) : 1,15,8,35] - [Par.35][Par.3][ IP(s) : 35,1,29,2] - [Par.35][Par.9][ IP(s) : 35,10,14,0] - [Par.3][Par.14][ IP(s) : 8,35,29,34] - [Par.35][Par.14][ IP(s) : 35,3,32,6] -
IP.8. Anti-Weight/ Compensation (Pos.3)	IP. Tac.	II / III / IV	[Par.9][Par.3][ IP(s) : 13,14,8,0] - [Par.14][Par.3][ IP(s) : 1,15,8,35] - [Par.3][Par.9][ IP(s) : 13,4,8,0] - [Par.14][Par.9][ IP(s) : 8,13,26,14] - [Par.3][Par.14][ IP(s) : 8,35,29,34] - [Par.9][Par.14][ IP(s) : 8,3,26,14] -
IP.15. Dynamics (Pos.4)	IP. Str.	II / III / IV	[Par.14][Par.3][ IP(s) : 1,15,8,35] - [Par.3][Par.35][ IP(s) : 14,15,1,16] - [Par.9][Par.35][ IP(s) : 15,10,26,0] - [Par.14][Par.35][ IP(s) : 15,3,32,0] -
IP.13. Reverse or Indirect Action (Pos.5)	IP. Str.	II / III / IV	[Par.9][Par.3][ IP(s) : 13,14,8,0] - [Par.3][Par.9][ IP(s) : 13,4,8,0] - [Par.14][Par.9][ IP(s) : 8,13,26,14] -
IP.34. Discarding and Recovering (Pos.6) ***	IP. Tac.	II / IV	[Par.34][Par.9][ IP(s) : 34,9,0,0] - [Par.3][Par.14][ IP(s) : 8,35,29,34] - [Par.9][Par.34][ IP(s) : 34,2,28,27] -
IP.14. Spheroidality - Curvature - Angle (Pos.7)	IP. Tac.	II / III / IV	[Par.9][Par.3][ IP(s) : 13,14,8,0] - [Par.14][Par.9][ IP(s) : 8,13,26,14] - [Par.35][Par.9][ IP(s) : 35,10,14,0] - [Par.9][Par.14][ IP(s) : 8,3,26,14] - [Par.3][Par.35][ IP(s) : 14,15,1,16] -
IP.11. Beforehand Cushioning (Pos.8)	IP. Tac.	II / III / IV	[Par.34][Par.14][ IP(s) : 11,1,2,9] - [Par.14][Par.34][ IP(s) : 27,11,3,0] -
IP.7. Nesting/ Dispersing (Pos.9) ***	IP. Tac.	II / IV	[Par.34][Par.35][ IP(s) : 7,1,4,16] - [Par.35][Par.34][ IP(s) : 1,16,7,4] -
IP.27. Cheap Short-Living Objects (Pos.10)	IP. Str.	II / III / IV	[Par.9][Par.34][ IP(s) : 34,2,28,27] - [Par.14][Par.34][ IP(s) : 27,11,3,0] -
IP.3. Local Quality (Pos.11)	IP. Str.	II / III / IV	[Par.9][Par.14][ IP(s) : 8,3,26,14] - [Par.35][Par.14][ IP(s) : 35,3,32,6] - [Par.14][Par.35][ IP(s) : 15,3,32,0] - [Par.14][Par.34][ IP(s) : 27,11,3,0] -
IP.10. Preliminary Action (Pos.12) ***	IP. Str.	II / IV	[Par.34][Par.3][ IP(s) : 1,28,10,25] - [Par.35][Par.9][ IP(s) : 35,10,14,0] - [Par.9][Par.35][ IP(s) : 15,10,26,0] - [Par.3][Par.34][ IP(s) : 1,28,10,0] -
IP.28. Mechanics Substitution (Pos.13) ***	IP. Str.	II / IV	[Par.34][Par.3][ IP(s) : 1,28,10,25] - [Par.3][Par.34][ IP(s) : 1,28,10,0] - [Par.9][Par.34][ IP(s) : 34,2,28,27] -
IP.4. Asymmetry/ Symmetry (Pos.14) ***	<b>IP. Oper.</b>	II / IV	[Par.3][Par.9][ IP(s) : 13,4,8,0] - [Par.34][Par.35][ IP(s) : 7,1,4,16] - [Par.35][Par.34][ IP(s) : 1,16,7,4] -
IP.2. Taking out/ Adding (Pos.15)	IP. Str.	II / III / IV	[Par.35][Par.3][ IP(s) : 35,1,29,2] - [Par.34][Par.14][ IP(s) : 11,1,2,9] - [Par.9][Par.34][ IP(s) : 34,2,28,27] -

IP.16. Partial or Excessive Actions (Pos.16) ***	IP. Oper.	II / IV	[Par.3][Par.35][ IP(s) : 14,15,1,16] - [Par.34][Par.35][ IP(s) : 7,1,4,16] - [Par.35][Par.34][ IP(s) : 1,16,7,4] -
IP.9. Preliminary Anti-action (Pos.17) ***	IP. Oper.	II /	[Par.34][Par.9][ IP(s) : 34,9,0,0] - [Par.34][Par.14][ IP(s) : 11,1,2,9] -
IP.26. Copying/ Replicating (Pos.18)	IP. Str.	II / III / IV	[Par.14][Par.9][ IP(s) : 8,13,26,14] - [Par.9][Par.14][ IP(s) : 8,3,26,14] - [Par.9][Par.35][ IP(s) : 15,10,26,0] -
IP.32. Perception/ Appearance/ Color Changes (Pos.19) ***	IP. Str.	II / IV	[Par.35][Par.14][ IP(s) : 35,3,32,6] - [Par.14][Par.35][ IP(s) : 15,3,32,0] -
IP.29. Controllable Soft Variables (Pos.20)	IP. Tac.	II / III / IV	[Par.35][Par.3][ IP(s) : 35,1,29,2] - [Par.3][Par.14][ IP(s) : 8,35,29,34] -
IP.25. Self-service (Pos.21) ***	IP. Oper.	II /	[Par.34][Par.3][ IP(s) : 1,28,10,25] -
IP.6. Universality (Pos.22) ***	IP. Tac.	II /	[Par.35][Par.14][ IP(s) : 35,3,32,6] -

**TABLE IX. RECOMMENDED SOLUTION ACCORDING TO THE MOST RELEVANT CONTRADICTIONS IDENTIFIED FOR THE EVALUATED OBJECT: LOCKING PIN**

CHALLENGE: Improve Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts

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 LOCKING PIN when it interacts with MALE-FEMALE PARTS OF CLOSING MECHANISM and there is an affected function: Removal of the locking pin from the male-female parts of the locking mechanism affected by the locking and rubbing between the pin and the male-female parts, in a specific space and time. LOCKING PIN 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 LOCKING PIN with an asterisk. Do not read the name of the evaluated object literally; associate it with a possible solution for LOCKING PIN\*.

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 LOCKING PIN, 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 LOCKING PIN NEED TO SATISFY: 34. Ease of change, repair or maintain**

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: (-) 14. Strength / Resistance**

TO IMPROVE (UDE): LOCKING PIN has Less Strength or resistance interacting with S2

#### **Parameter to attenuate or preserve: (+) 3. Length of moving object**

TO ATTENUATE OR PRESERVE (UDE): LOCKING PIN has More Own length or relative distance, whether physical or figurative interacting with S2

#### **Inventive principles IP(s) : [1,15,8,35]**

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

- a. Divide LOCKING PIN\* 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 LOCKING PIN\* into a single entity..
- c. Make LOCKING PIN\* easy to disassemble or assemble.
- d. Increase or reduce the degree of fragmentation or segmentation of LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation in space / Separation in subsystem

Solution strategy for LOCKING PIN\* : 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.4):**

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

nearby environment.

Separation principle for LOCKING PIN\* : Separation in time

Solution strategy for LOCKING PIN\* : 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.3):**

a. To compensate for the heaviness/lightness or incidence of LOCKING PIN\*, 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 LOCKING PIN\*, make it interact with the environment.

For example, compensate for the heaviness of LOCKING PIN\* 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 LOCKING PIN\* : Separation alternative

Solution strategy for LOCKING PIN\* : Improving attributes

### **35. Transformation/ Parameter Changes, Str. IP (Pos.2):**

a. Change LOCKING PIN\*'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 LOCKING PIN\* 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 LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation by condition / Separation alternative

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

## **COMPLEMENTARY CONTRADICTION 1**

### **Contradiction order wt.3**

#### **Parameter to improve: (-) 9. Speed**

TO IMPROVE (UDE): LOCKING PIN has Less Speed or rate of change interacting with S2

#### **Parameter to attenuate or preserve: (+) 3. Length of moving object**

TO ATTENUATE OR PRESERVE (UDE): LOCKING PIN has More Own length or relative distance, whether physical or figurative interacting with S2

**Inventive principles IP(s) : [13,14,8,0]**

### **13. Inverse or Indirect Action, Str. IP (Pos.5):**

a. Inverse the applied action or apply an indirect action to perform the current function of LOCKING PIN\* to interact with object (S2)

It should be identified how LOCKING PIN\* currently performs an action with S2 Object and from there evaluate an inverse or indirect action.

b. Make moving parts of LOCKING PIN\* (or the external environment) fixed, and fixed parts moving.

c. Turn LOCKING PIN\* (or process) "upside down", "change the position", "change the condition".

Separation principle for LOCKING PIN\* : Separation in space / Separation inverse

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

#### **14. Spheroidality – Curvature - Angle, Tac. IP (Pos.7):**

- a. For the interaction between LOCKING PIN\* and S2 Object, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.
- b. For the interaction between LOCKING PIN\* 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 LOCKING PIN\* 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, LOCKING PIN\*.
- e. Go from linear to rotary motion, use centrifugal forces in, or for, LOCKING PIN\*.
- f. If there is Spheroidality, curvature or angle, increase or reduce, as applicable, in, or for, LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation alternative

Solution strategy for LOCKING PIN\* : Improving attributes; Improving if a solution has not yet emerged

#### **8. Anti-weight/ Compensation, Tac. IP (Pos.3):**

- a. To compensate for the heaviness/lightness or incidence of LOCKING PIN\*, 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 LOCKING PIN\*, make it interact with the environment.

For example, compensate for the heaviness of LOCKING PIN\* 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 LOCKING PIN\* : Separation alternative

Solution strategy for LOCKING PIN\* : Improving attributes

### **COMPLEMENTARY CONTRADICTION 2**

#### **Contradiction order wt.5**

#### **Parameter to improve: (-) 14. Strength / Resistance**

TO IMPROVE (UDE): LOCKING PIN has Less Strength or resistance interacting with S2

#### **Parameter to attenuate or preserve: (-) 9. Speed**

TO ATTENUATE OR PRESERVE (UDE): LOCKING PIN has Less Speed or rate of change interacting with S2

#### **Inventive principles IP(s) : [8,13,26,14]**

#### **8. Anti-weight/ Compensation, Tac. IP (Pos.3):**

- a. To compensate for the heaviness/lightness or incidence of LOCKING PIN\*, 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 LOCKING PIN\*, make it interact with the environment.

For example, compensate for the heaviness of LOCKING PIN\* 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 LOCKING PIN\* : Separation alternative

Solution strategy for LOCKING PIN\* : Improving attributes

#### **13. Inverse or Indirect Action, Str. IP (Pos.5):**

- a. Inverse the applied action or apply an indirect action to perform the current function of LOCKING PIN\* to interact with object (S2)

It should be identified how LOCKING PIN\* currently performs an action with S2 Object and from there evaluate an inverse or indirect action.

b. Make moving parts of LOCKING PIN\* (or the external environment) fixed, and fixed parts moving.

c. Turn LOCKING PIN\* (or process) “upside down”, “change the position”, “change the condition”.

Separation principle for LOCKING PIN\* : Separation in space / Separation inverse

Solution strategy for LOCKING PIN\* : 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 LOCKING PIN\*, 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 LOCKING PIN\*, 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 LOCKING PIN\* : Separation in space

Solution strategy for LOCKING PIN\* : Improving if a solution has not yet emerged

#### **14. Spheroidality – Curvature - Angle, Tac. IP (Pos.7):**

a. For the interaction between LOCKING PIN\* and S2 Object, instead of using rectilinear parts, surfaces, or shapes, use curvilinear, enveloping, or angled parts.

b. For the interaction between LOCKING PIN\* 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 LOCKING PIN\* 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, LOCKING PIN\*.

e. Go from linear to rotary motion, use centrifugal forces in, or for, LOCKING PIN\*.

f. If there is Spheroidality, curvature or angle, increase or reduce, as applicable, in, or for, LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation alternative

Solution strategy for LOCKING PIN\* : Improving attributes; Improving if a solution has not yet emerged

### **COMPLEMENTARY CONTRADICTION 3**

#### **Contradiction order wt.9**

#### **Parameter to improve: (-) 35. Adaptability or versatility**

TO IMPROVE (UDE): LOCKING PIN has Less Adaptability or versatility to interaction variability of S2

#### **Parameter to attenuate or preserve: (+) 3. Length of moving object**

TO ATTENUATE OR PRESERVE (UDE): LOCKING PIN has More Own length or relative distance, whether physical or figurative interacting with S2

**Inventive principles IP(s) : [35,1,29,2]**

#### **35. Transformation/ Parameter Changes, Str. IP (Pos.2):**

a. Change LOCKING PIN\*'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 LOCKING PIN\* 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 LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation by condition / Separation alternative

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

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

a. Divide LOCKING PIN\* 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 LOCKING PIN\* into a single entity..

c. Make LOCKING PIN\* easy to disassemble or assemble.

d. Increase or reduce the degree of fragmentation or segmentation of LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation in space / Separation in subsystem

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

**29. Controllable Soft Variables, Tac. IP (Pos.20):**

a. Use external, controllable soft variables (manual, physical, mechanical, pneumatic, hydraulic, electrical, magnetic, electromagnetic, digital, chemical, biological, social, psychological, physiological , etc.) to interact with LOCKING PIN\* facilitating goal fulfillment of the function performed with S2 Object.

b. Make easier LOCKING PIN\* interact with S2 Object using internal, controllable soft variables (manual, physical, mechanical, pneumatic, hydraulic, electrical, magnetic, electromagnetic, digital, chemical, biological, social, psychological, physiological , etc.) available in S1 and / or S2, facilitating goal fulfillment.

Separation principle for LOCKING PIN\* : Separation in time

Solution strategy for LOCKING PIN\* : Improving if a solution has not yet emerged

**2. Taking Out/ Adding, Str. IP (Pos.15):**

a. Separate an interfering part or a property from LOCKING PIN\*, or single out the only necessary part (or property) of LOCKING PIN\*.

b. Add new parts or properties to LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation in space

Solution strategy for LOCKING PIN\* : Improving attributes

**COMPLEMENTARY CONTRADICTION 4**

**Contradiction order wt.15**

**Parameter to improve: (-) 14. Strength / Resistance**

TO IMPROVE (UDE): LOCKING PIN has Less Strength or resistance interacting with S2

**Parameter to attenuate or preserve: (+) 34. Ease of change, repair or maintain**

TO PRESERVE (DE): LOCKING PIN has More Desired ease of change, repair or maintenance to interact with S2

**Inventive principles IP(s) : [27,11,3,0]**

**27. Cheap Short-Living Objects, Str. IP (Pos.10):**

a. Replace or divide (either fully or partially) LOCKING PIN\* 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 LOCKING PIN\* (e.g., the degree of participation, complexity, or

lifetime), with no loss of functionality, to achieve the desired objective.

Separation principle for LOCKING PIN\* : Separation in subsystem

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

**11. Beforehand Cushioning, Tac. IP (Pos.8):**

a. Prepare emergency means, beforehand, to compensate for the relatively low reliability of LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation in time

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

**3. Local quality, Str. IP (Pos.11):**

a. Improve quality in a localized way, for parts, components, or conditions of LOCKING PIN\*.

b. Change the structure, action, or procedure of LOCKING PIN\* from uniform to non-uniform, or vice versa.

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

d. Make each part of LOCKING PIN\* function in the conditions that are most suitable for its operation.

e. Make each part of LOCKING PIN\* fulfill a different and useful function.

Separation principle for LOCKING PIN\* : Separation in space

Solution strategy for LOCKING PIN\* : Improving attributes; Improving performance; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security); 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 34. Ease of change, repair or maintain**

MEJORAR > LOCKING PIN tiene More Desired ease of change, repair or maintenance to interact with S2

**Parameter to preserve 33. Ease of operation**

PRESERVAR > LOCKING PIN tiene más efecto deseable por parámetro 33. Ease of operation

**Inventive principles IP(s) : [1,12,26,15]**

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

a. Divide LOCKING PIN\* 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 LOCKING PIN\* into a single entity..

c. Make LOCKING PIN\* easy to disassemble or assemble.

d. Increase or reduce the degree of fragmentation or segmentation of LOCKING PIN\*.

Separation principle for LOCKING PIN\* : Separation in space / Separation in subsystem

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

**12.- Equipotentiality, Tac. IP (Pos.):**

a. In a potential field, limit position changes or energy variations of LOCKING PIN\*.

b. Change operating conditions to eliminate the need to change the position or energy quality of

LOCKING PIN\* in a potential field.

Separation principle for LOCKING PIN\* : Separation by condition to satisfy contradiction

Solution strategy for LOCKING PIN\* : Improving if a solution has not yet emerged

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

a. Instead of using LOCKING PIN\*, 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 LOCKING PIN\*, 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 LOCKING PIN\* : Separation in space

Solution strategy for LOCKING PIN\* : Improving if a solution has not yet emerged

### **15. Dynamics, Str. IP (Pos.4):**

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

b. Divide LOCKING PIN\* into parts that are capable of relative movement between each other.

c. If LOCKING PIN\* (or process) is rigid or inflexible, make it flexible or adaptive.

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

Separation principle for LOCKING PIN\* : Separation in time

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

## **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.

### **ALGORITHM AATRIZINVENTOR FROM NATURE'S L.I.**