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

INNOVATION CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

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.
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FACTORS OF INNOVATION:
FUNCTION AFFECTED: Movement of an animal pulled by a farmer affected by the animal's reluctance to walk
PHYSICAL VARIABLE OR CHARACTERISTIC: Less Ability to move animal
S1 OBJECT: FARMER Type: Moving
S2 OBJECT: ANIMAL Type: Moving
DESIRED ACTION VERB: Improve

INNOVATION CHALLENGE:
CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk
DESIRED GOAL: More Ability to move animal
EVALUATED OBJECT: FARMER
NEED TO SATISFY > 27. Reliability

SELECTED INNOVATION PARAMETERS TO EVALUATE:
A. UNDESIRABLE EFFECTS CAUSES OF DISSATISFACTION (UDEs)
There are More difficulty to Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk because:
FARMER Has Less Force or impulse interacting with S2
FARMER Has Less Appropriate shape, composition, or configuration interacting with S2
FARMER Has Less Strength or resistance interacting with S2
FARMER Has Less Power or energy per unit of time interacting with S2
There are undesirable effects that cause dissatisfaction because:
There is Less Ability to move animal
B. DESIRED EFFECT FOR NEED TO SATISFY
There is More ease to Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk because:
FARMER Has More Desired reliability to interact with S2
There is desirable effect for need to satisfy because:
There is More Ability to move animal

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

undesirable effects)
CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

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 FARMER has:
Parámeters of undesirable effects (UDE):	**Undesirable effects causes of dissatisfaction:**
(-) 10. Force/ Intensity	Less Force or impulse interacting with S2
(-) 12. Shape / composition / configuration	Less Appropriate shape, composition, or configuration interacting with S2
(-)14. Strength / Resistance	Less Strength or resistance interacting with S2
(-) 21. Power/ Energy per unit of time	Less Power or energy per unit of time interacting with S2
Desirable parameter (DE):	**Desirable Effect for Need to satisfy:**
(+) 27. Reliability	More Desired reliability to interact with S2
TRIZ undesirables parameters for sensitivity analysis	**It is understood as FARMER has:**
(-) 9. Speed	Less Speed or rate of change interacting with S2
(-) 29. Fulfillment of desired outcome	Less Achievement of desired outcome interacting with S2
n/a	
n/a	
n/a	

EVALUTION RESULTS TABLES

TABLE II. SPECIFIC CONTRADICTION MATRIX FOR UNDESIRABLE EFFECTS AND NEED TO SATISFY.
FOR EVALUATED OBJECT: FARMER AND NEED TO BE SATISFIED > 27. Reliability

CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

(*) Preferred parameters: Improve 14. Strength / Resistance & Attenuate or preserve 21. Power/ Energy per unit 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.10	(-) Par.12	(-) Par.14	(-) Par.21 PREF.	(+) Par.27	Sum wt
(-) 10. Force/ Intensity	wt		wt.14	wt.10	wt.13 Compl.	wt.9	32%
	IP(s)	0,0,0,0	10,35,40,34	35,10,14,27	19,35,18,37	3,35,13,21	
(-) 12. Shape / composition / configuration	wt	wt.7		wt.5 Top 5	wt.20 Compl.	wt.18	35%
	IP(s)	35,10,37,40	0,0,0,0	30,14,10,40	4,6,2,0	10,40,16,0	
(-) 14. Strength / Resistance PREF.	wt	wt.6 Compl.	wt.2 Compl.		wt.1 E.C.	wt.8 Compl.	100%
	IP(s)	10,18,3,14	10,30,35,40	0,0,0,0	10,26,35,28	11,3,0,0	
(-) 21. Power/ Energy per unit of time	wt	wt.12	wt.16	wt.4 Top 5		wt.19	35%
	IP(s)	26,2,36,35	29,14,2,40	26,10,28,0	0,0,0,0	19,24,26,31	
(+) 27. Reliability	wt	wt.3 Top 5	wt.11	wt.17	wt.15 Compl.		41%
	IP(s)	8,28,10,3	35,1,16,11	11,28,0,0	21,11,26,31	0,0,0,0	
Sum wt		51%	51%	45%	69%	28%	

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: FARMER

NEED TO SATISFY > 27. Reliability

CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

Table II Selection: Essential Contradiction wt.1 y Complementary contradictions with preferred parameters (*) wt.2/wt.6/wt.8/wt.13							
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	(-) 21. Power/ Energy per unit of time	Essential	wt.1	**10 Es.**	**26 Es.**	**35 Es.**	**28 Es.**
(-) 14. Strength / Resistance	(-) 12. Shape / composition / configuration	Compl. 1	wt.2	**10 Es.**	30	**35 Es.**	40
(-) 14. Strength / Resistance	(-) 10. Force/ Intensity	Compl. 2	wt.6	**10 Es.**	18	3	14
(-) 14. Strength / Resistance	(+) 27. Reliability	Compl. 3	wt.8	11	3	0	0
(-) 10. Force/ Intensity	(-) 21. Power/ Energy per unit of time	Compl. 4	wt.13	19	**35 Es.**	18	37

Inventive Principles (IP) selected for the Base Solution
IP.10. Preliminary Action - strategic type
IP.26. Copying/ Replicating - strategic type
IP.35. Transformation / Parameter Changes - strategic type
IP.28. Mechanics Substitution - strategic type
IP.30. Simple Shapes/ Ways to Interact - tactical type
IP.40. Composite Materials/ Conditions - **operative type**
IP.18. Mechanical Vibrations/ Energy Variations - tactical type
IP.3. Local Quality - strategic type
IP.14. Spheroidality - Curvature - Angle - tactical type
IP.11. Beforehand Cushioning - tactical type
IP.19. Time-Varying Action/ Periodic or Pulsating - strategic type
IP.37. Useful Perceptible Change - **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: FARMER, NEED TO BE SATISFY: 27. Reliability

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
27. Reliability	33. Ease of operation	27	**17 nT2**	40	0
27. Reliability	39. Productivity	1	35	29	**38 nT2**
27. Reliability	15. Duration of action of moving object	2	35	3	**25 nT2**
27. Reliability	34. Ease of change, repair or maintain	1	11	0	0
27. Reliability	32. Ease of achieving desired outcome	0	0	0	0
27. Reliability	19. Use of energy by moving object	21 nT3	11	27	19
27. Reliability	27. Reliability	0	0	0	0
27. Reliability	38. Extent of automation/ autonomy	11	13 nT3	27	0
27. Reliability	35. Adaptability or versatility	13 nT3	35	8 nT3	24 nT3
27. Reliability	13. Stability	0	0	0	0

Inventive Principles (IP) selected for the Solution of relevant Contradictions between Needs to Satisfy
IP.27. Cheap Short-Living Objects - strategic tpe
IP.17. Another Dimension or Field - tactical type
IP.40. Composite Materials/ Conditions - **operative type**
IP.1. Segmenting/ Integrating - strategic tpe
IP.35. Transformation / Parameter Changes - strategic tpe
IP.29. Controllable Soft Variables - tactical type

IP.38. Strong or Quick Reactions - **operative type**
IP.2. Taking out/ Adding - strategic tpe
IP.3. Local Quality - strategic tpe
IP.25. Self-service - **operative type**

95.25 % 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 FARMER.

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 FARMER

CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

Evaluated need to satisfy in this report: **27. Reliability**

UDEs: (-) 10. Force/ Intensity// (-) 12. Shape / composition / configuration// (-)14. Strength / Resistance// (-) 21. Power/ Energy per unit of time

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	(-) 21. Power/ Energy per unit of time	Essential	wt.1	10 Es.	26 Es.	35 Es.	28 Es.
(-) 14. Strength / Resistance	(-) 12. Shape / composition / configuration	Compl. 1	wt.2	10 Es.	30	35 Es.	40
(-) 14. Strength / Resistance	(-) 10. Force/ Intensity	Compl. 2	wt.6	10 Es.	18	3	14

(-) 14. Strength / Resistance	(+) 27. Reliability	Compl. 3	wt.8	11	3	0	0
(-) 10. Force/ Intensity	(-) 21. Power/ Energy per unit of time	Compl. 4	wt.13	19	**35 Es.**	18	37
27. Reliability	33. Ease of operation	NS.1	wns.1	27	17	40	0
27. Reliability	39. Productivity	NS.2	wns.2	1	**35 Es.**	29	38
27. Reliability	15. Duration of action of moving object	NS.3	wns.3	2	**35 Es.**	3	25

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.21. Skipping/ Avoiding (Pos.8) ***	IP. Tac.	[Par.27][Par.21][IP(s) : 21,11,26,31] - [Par.10][Par.27][IP(s) : 3,35,13,21] -
IP.8. Anti-Weight/ Compensation (Pos.10) ***	IP. Tac.	[Par.27][Par.10][IP(s) : 8,28,10,3] -
IP.4. Asymmetry/ Symmetry (Pos.11) ***	**IP. Oper.**	[Par.12][Par.21][IP(s) : 4,6,2,0] -

Inventive Principles (IP) selected for Recommended Solution:

To develop a Specific Solution based on the contradictions provided in Table V, where S1: FARMER interacts with S2: ANIMAL, 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 FARMER 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: (-) 21. Power/ Energy per unit of time

IP.10. Preliminary Action - strategic type (1)

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

b. Pre-arrange FARMER* 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.26. Copying/ Replicating - strategic type (2)

a. Instead of using FARMER*, 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 FARMER*, 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.35. Transformation / Parameter Changes - strategic type (3)

a. Change FARMER*'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 FARMER* 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 FARMER*.

IP.28. Mechanics Substitution - strategic type (4)

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

b. Replace a mechanical means in, or for, FARMER*, 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 FARMER*.

d. Change from static fields in, or for, FARMER* 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, FARMER*.

N°2 Improve: (-) 14. Strength / Resistance and Attenuate or Preserve: (-) 12. Shape / composition / configuration

IP.10. Preliminary Action - strategic type (5)

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

b. Pre-arrange FARMER* 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.30. Simple Shapes/ Ways to Interact - tactical type (6)

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

b. Separate/isolate FARMER* 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 FARMER* 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.35. Transformation / Parameter Changes - strategic type (7)

a. Change FARMER*'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 FARMER* 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 FARMER*.

IP.40. Composite Materials/ Conditions - operative type (8)

a. Change from a uniform material, property, state, or condition in, or for, FARMER* , to a composite one, or vice versa.

N°3 Improve: (-) 14. Strength / Resistance and Attenuate or Preserve: (-) 10. Force/ Intensity

IP.10. Preliminary Action - strategic type (9)

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

b. Pre-arrange FARMER* 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.18. Mechanical Vibrations/ Energy Variations - tactical type (10)

a. Move FARMER* by cycles with energies that activate it.

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

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

d. Apply alternation of FARMER* or its parts or functions.

IP.3. Local Quality - strategic type (11)

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

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

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

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

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

IP.14. Spheroidality - Curvature - Angle - tactical type (12)

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

b. For the interaction between FARMER* 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 FARMER* 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, FARMER*.

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

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

N°4 Improve: (-) 14. Strength / Resistance and Attenuate or Preserve: (+) 27. Reliability
IP.11. Beforehand Cushioning - tactical type (13)

a. Prepare emergency means, beforehand, to compensate for the relatively low reliability of FARMER*.
IP.3. Local Quality - strategic type (14)

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

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

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

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

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

N°5 Improve: (-) 10. Force/ Intensity and Attenuate or Preserve: (-) 21. Power/ Energy per unit of time
IP.19. Time-Varying Action/ Periodic or Pulsating - strategic type (15)

a. Instead of using continuous action in, or for, FARMER*, use time-varying, periodic, or pulsating actions.

b. If the action of FARMER* is already periodic, change the periodic magnitude or frequency.

c. Use pauses between impulses to perform a different action of FARMER*.

d. If the current action of FARMER* is time-varying, and if necessary, change to an action higher or lesser time-varying.
IP.35. Transformation / Parameter Changes - strategic type (16)

a. Change FARMER*'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 FARMER* 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 FARMER*.
IP.18. Mechanical Vibrations/ Energy Variations - tactical type (17)

a. Move FARMER* by cycles with energies that activate it.

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

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

d. Apply alternation of FARMER* or its parts or functions.
IP.37. Useful Perceptible Change - operative type (18)

a. Use state, dimension or condition changes occurring to FARMER*, because of a modification or application of an external or self-generated field, which is perceptible by and can influence to object S2 with which it interacts. The change may be permanent or variable in time.

N°6 Improve: 27. Reliability and Preserve: 33. Ease of operation
IP.27. Cheap Short-Living Objects - strategic type (19)

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

IP.17. Another Dimension or Field - tactical type (20)

a. Add or remove physical dimensions or fields of action of FARMER*.

b. Move FARMER* to a new dimension in space or performance field.

c. Use for FARMER* multi-story arrangement of objects instead of a single-story arrangement.

d. Tilt or re-orient FARMER*; lay it on its side.

e. Use another side of a given dimension or field of FARMER*.

IP.40. Composite Materials/ Conditions - operative type (21)

a. Change from a uniform material, property, state, or condition in, or for, FARMER* , to a composite one, or vice versa.

N°7 Improve: 27. Reliability and Preserve: 39. Productivity

IP.1. Segmenting/ Integrating - strategic type (22)

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

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

c. Make FARMER* easy to disassemble or assemble.

d. Increase or reduce the degree of fragmentation or segmentation of FARMER*.

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

a. Change FARMER*'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 FARMER* 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 FARMER*.

IP.29. Controllable Soft Variables - tactical type (24)

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

b. Make easier FARMER* 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.38. Strong or Quick Reactions - operative type (25)

a. Apply strong and/or quick reactions to FARMER* (e.g., apply strong oxidants, sudden change.).

N°8 Improve: 27. Reliability and Preserve: 15. Duration of action of moving object

IP.2. Taking out/ Adding - strategic type (26)

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

IP.35. Transformation / Parameter Changes - strategic type (27)

a. Change FARMER*'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 FARMER* 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 FARMER*.

IP.3. Local Quality - strategic type (28)

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

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

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

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

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

IP.25. Self-service - operative type (29)

a. Make FARMER* serve itself by performing helpful auxiliary functions.

b. Use resources, energy or substances that are wasted or unused by FARMER*. **c.** Incorporate resources and/or functions into FARMER* for self-service during operation.

Relevant inventive principles from Table II not included in Recommended Solution

IP.21. Skipping/ Avoiding (Pos.(8) - tactical type (30)

a. Make sure that with FARMER*, 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 FARMER*.

(Pos.() (31)

IP.4. Asymmetry/ Symmetry (Pos.(11) - operative type (32)

a. Change the shape of FARMER* from symmetrical to asymmetrical, permanent, or variable in time, or vice versa.

b. If FARMER* is asymmetrical, increase its degree of asymmetry, or vice versa.

TABLE VI. RESULTS OF SENSITIVITY ANALYSIS FOR THE EVALUATED OBJECT FARMER
CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

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 (%)
#	10	12	14	21	27. Reliability	95.25	100	96.43

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	10	12	14	21	27. Reliability **(E)**	95.25	100	96.43
II.a	10	14	21	29	27. Reliability	93.88	100	95.41
III.a	9	10	12	14	35. Adaptability or versatility	92.57	100	94.43
IV.a	9	12	14	21	13. Stability	91.54	100	93.66
V.a	9	10	12	29	19. Use of energy by moving object	90.26	100	92.7

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	9	10	12	21	27. Reliability	96.16	33.42	80.48	-
II.b	9	12	14	21	27. Reliability	96.16	22.01	77.62	-
III.b	9	10	21	29	27. Reliability	95.72	17.8	76.24	-
IV.b	9	12	14	21	32. Ease of achieving desired outcome	95.6	43.62	82.6	-
V.b	10	12	14	21	27. Reliability **(E)**	95.25	100	96.43	I.a

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

CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

Evaluated need to satisfy in this report: **27. Reliability**

UDEs: (-) 10. Force/ Intensity// (-) 12. Shape / composition / configuration// (-)14. Strength / Resistance// (-) 21. Power/ Energy per unit of time

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

27. Reliability	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	95.25	100	96.43
13. Stability	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	89.78	100	92.33
32. Ease of achieving desired outcome	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	88.14	100	91.1
35. Adaptability or versatility	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	81.05	100	85.79
38. Extent of automation/ autonomy	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	79.05	100	84.28
33. Ease of operation	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	77.27	100	82.95
19. Use of energy by moving object	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	71.47	100	78.61
34. Ease of change, repair or maintain	(-) 10. Force/ Intensity	(-)14. Strength / Resistance	[35,10,14,27]	87.06	19.44	70.16
39. Productivity	(-)14. Strength / Resistance	(-) 21. Power/ Energy per unit of time	[10,26,35,28]	54.9	100	66.18
15. Duration of action of moving object	(-) 10. Force/ Intensity	(-)14. Strength / Resistance	[35,10,14,27]	65.36	19.44	53.88

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: 27. Reliability.

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

CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

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

Evaluated parameters for Object FARMER:

Par. UDEs:

(-) 10. Force/ Intensity

(-) 12. Shape / composition / configuration

(-)14. Strength / Resistance

(-) 21. Power/ Energy per unit of time

Par. NS: (+) 27. Reliability

***: 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.10. Preliminary Action (Pos.1)	IP. Str.	II / III /	[Par.12][Par.10][IP(s) : 35,10,37,40] - [Par.14][Par.10][IP(s) : 10,18,3,14] - [Par.27][Par.10][IP(s) : 8,28,10,3] - [Par.10][Par.12][IP(s) : 10,35,40,34] - [Par.14][Par.12][IP(s) : 10,30,35,40] - [Par.10][Par.14][IP(s) : 35,10,14,27] - [Par.12][Par.14][IP(s) : 30,14,10,40] - [Par.21][Par.14][IP(s) : 26,10,28,0] - [Par.14][Par.21][IP(s) : 10,26,35,28] - [Par.12][Par.27][IP(s) : 10,40,16,0] -
IP.35. Transformation / Parameter Changes (Pos.2)	IP. Str.	II / III / IV	[Par.12][Par.10][IP(s) : 35,10,37,40] - [Par.21][Par.10][IP(s) : 26,2,36,35] - [Par.10][Par.12][IP(s) : 10,35,40,34] - [Par.14][Par.12][IP(s) : 10,30,35,40] - [Par.27][Par.12][IP(s) : 35,1,16,11] - [Par.10][Par.14][IP(s) : 35,10,14,27] - [Par.10][Par.21][IP(s) : 19,35,18,37] - [Par.14][Par.21][IP(s) : 10,26,35,28] - [Par.10][Par.27][IP(s) : 3,35,13,21] -
IP.26. Copying/ Replicating (Pos.3)	IP. Str.	II / III /	[Par.21][Par.10][IP(s) : 26,2,36,35] - [Par.21][Par.14][IP(s) : 26,10,28,0] - [Par.14][Par.21][IP(s) : 10,26,35,28] - [Par.27][Par.21][IP(s) : 21,11,26,31] - [Par.21][Par.27][IP(s) : 19,24,26,31] -
IP.11. Beforehand Cushioning (Pos.4)	IP. Tac.	II / III / IV	[Par.27][Par.12][IP(s) : 35,1,16,11] - [Par.27][Par.14][IP(s) : 11,28,0,0] - [Par.27][Par.21][IP(s) : 21,11,26,31] - [Par.14][Par.27][IP(s) : 11,3,0,0] -

IP.19. Time-Varying Action/ Periodic or Pulsating (Pos.5)	IP. Str.	II / III / IV	[Par.10][Par.21][IP(s) : 19,35,18,37] - [Par.21][Par.27][IP(s) : 19,24,26,31] -
IP.3. Local Quality (Pos.6)	IP. Str.	II / III / IV	[Par.14][Par.10][IP(s) : 10,18,3,14 - [Par.27][Par.10][IP(s) : 8,28,10,3] - [Par.10][Par.27][IP(s) : 3,35,13,21] - [Par.14][Par.27][IP(s) : 11,3,0,0] -
IP.30. Simple Shapes/ Ways to Interact (Pos.7)	IP. Tac.	II / III /	[Par.14][Par.12][IP(s) : 10,30,35,40] - [Par.12][Par.14][IP(s) : 30,14,10,40] -
IP.21. Skipping/ Avoiding (Pos.8) ***	IP. Tac.	II / IV	[Par.27][Par.21][IP(s) : 21,11,26,31] - [Par.10][Par.27][IP(s) : 3,35,13,21] -
IP.29. Controllable Soft Variables (Pos.9)	IP. Tac.	II / IV	[Par.21][Par.12][IP(s) : 29,14,2,40] -
IP.8. Anti-Weight/ Compensation (Pos.10) ***	IP. Tac.	II / IV	[Par.27][Par.10][IP(s) : 8,28,10,3] -
IP.4. Asymmetry/ Symmetry (Pos.11) ***	**IP. Oper.**	II /	[Par.12][Par.21][IP(s) : 4,6,2,0] -
IP.28. Mechanics Substitution (Pos.12)	IP. Str.	II / III /	[Par.27][Par.10][IP(s) : 8,28,10,3] - [Par.21][Par.14][IP(s) : 26,10,28,0] - [Par.27][Par.14][IP(s) : 11,28,0,0] - [Par.14][Par.21][IP(s) : 10,26,35,28] -
IP.14. Spheroidality - Curvature - Angle (Pos.13)	IP. Tac.	II / III /	[Par.14][Par.10][IP(s) : 10,18,3,14] - [Par.21][Par.12][IP(s) : 29,14,2,40] - [Par.10][Par.14][IP(s) : 35,10,14,27] - [Par.12][Par.14][IP(s) : 30,14,10,40] -
IP.40. Composite Materials/ Conditions (Pos.14)	**IP. Oper.**	II / III / IV	[Par.12][Par.10][IP(s) : 35,10,37,40] - [Par.10][Par.12][IP(s) : 10,35,40,34] - [Par.14][Par.12][IP(s) : 10,30,35,40] - [Par.21][Par.12][IP(s) : 29,14,2,40] - [Par.12][Par.14][IP(s) : 30,14,10,40] - [Par.12][Par.27][IP(s) : 10,40,16,0] -
IP.2. Taking out/ Adding (Pos.15)	IP. Str.	II / IV	[Par.21][Par.10][IP(s) : 26,2,36,35] - [Par.21][Par.12][IP(s) : 29,14,2,40] - [Par.12][Par.21][IP(s) : 4,6,2,0] -
IP.18. Mechanical Vibrations/ Energy Variations (Pos.16)	IP. Tac.	II / III /	[Par.14][Par.10][IP(s) : 10,18,3,14] - [Par.10][Par.21][IP(s) : 19,35,18,37] -
IP.24. Intermediary (Pos.17) ***	IP. Tac.	II / IV	[Par.21][Par.27][IP(s) : 19,24,26,31] -

IP.6. Universality (Pos.18) ***	IP. Tac.	II /	[Par.12][Par.21][IP(s) : 4,6,2,0] -
IP.1. Segmenting/ Integrating (Pos.19)	IP. Str.	II / IV	[Par.27][Par.12][IP(s) : 35,1,16,11] -
IP.16. Partial or Excessive Actions (Pos.20) ***	**IP. Oper.**	II /	[Par.27][Par.12][IP(s) : 35,1,16,11] - [Par.12][Par.27][IP(s) : 10,40,16,0] -
IP.37. Useful Perceptible Change (Pos.21)	**IP. Oper.**	II / III /	[Par.12][Par.10][IP(s) : 35,10,37,40] - [Par.10][Par.21][IP(s) : 19,35,18,37] -
IP.36. Phase, State or Condition Transitions (Pos.22) ***	**IP. Oper.**	II /	[Par.21][Par.10][IP(s) : 26,2,36,35] -
IP.13. Reverse or Indirect Action (Pos.23) ***	IP. Str.	II / IV	[Par.10][Par.27][IP(s) : 3,35,13,21] -
IP.31. Using/ Removing Unused Parts (Pos.24) ***	**IP. Oper.**	II /	[Par.27][Par.21][IP(s) : 21,11,26,31] - [Par.21][Par.27][IP(s) : 19,24,26,31] -
IP.34. Discarding and Recovering (Pos.25) ***	IP. Tac.	II /	[Par.10][Par.12][IP(s) : 10,35,40,34] -
IP.27. Cheap Short-Living Objects (Pos.26)	IP. Str.	II / IV	[Par.10][Par.14][IP(s) : 35,10,14,27] -

TABLE IX. RECOMMENDED SOLUTION ACCORDING TO THE MOST RELEVANT CONTRADICTIONS IDENTIFIED FOR THE EVALUATED OBJECT: FARMER
CHALLENGE: Improve Movement of an animal pulled by a farmer affected by the animal's reluctance to walk

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 FARMER when it interacts with ANIMAL and there is an affected function: Movement of an animal pulled by a farmer affected by the animal's reluctance to walk, in a specific space and time. FARMER 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 FARMER with an asterisk. Do not read the name of the evaluated object literally; associate it with a possible solution for FARMER*.

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 FARMER, 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 FARMER
NEED TO SATISFY: 27. Reliability
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): FARMER has Less Strength or resistance interacting with S2
Parameter to attenuate or preserve: (-) 21. Power/ Energy per unit of time
TO ATTENUATE OR PRESERVE (UDE): FARMER has Less Power or energy per unit of time interacting with S2
Inventive principles IP(s) : [10,26,35,28]
10. Preliminary Action, Str. IP (Pos.1):
a. Perform the required change in, or for, FARMER*, before it is needed (either fully or partially).
b. Pre-arrange FARMER* 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 FARMER* : Separation in time
Solution strategy for FARMER* : Improving attributes; Improving performance
26. Copying/ Replicating, Str. IP (Pos.3):

a. Instead of using FARMER*, 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 FARMER*, 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 FARMER* : Separation in space
Solution strategy for FARMER* : Improving if a solution has not yet emerged
35. Transformation/ Parameter Changes, Str. IP (Pos.2):
a. Change FARMER*'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 FARMER* 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 FARMER*.
Separation principle for FARMER* : Separation by condition / Separation alternative
Solution strategy for FARMER* : Improving attributes; Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)
28. Mechanics Substitution, Str. IP (Pos.12):
a. Replace a direct or manual action in, or for, FARMER*, with a mechanical action or a tool.
b. Replace a mechanical means in, or for, FARMER*, 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 FARMER*.
d. Change from static fields in, or for, FARMER* 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, FARMER*.
Separation principle for FARMER* : Separation by condition
Solution strategy for FARMER* : Improving attributes

COMPLEMENTARY CONTRADICTION 1
Contradiction order wt.2

Parameter to improve: (-) 14. Strength / Resistance
TO IMPROVE (UDE): FARMER has Less Strength or resistance interacting with S2
Parameter to attenuate or preserve: (-) 12. Shape / composition / configuration
TO ATTENUATE OR PRESERVE (UDE): FARMER has Less Appropriate shape, composition, or configuration interacting with S2
Inventive principles IP(s) : [10,30,35,40]
10. Preliminary Action, Str. IP (Pos.1):
a. Perform the required change in, or for, FARMER*, before it is needed (either fully or partially).
b. Pre-arrange FARMER* 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 FARMER* : Separation in time

Solution strategy for FARMER* : Improving attributes; Improving performance

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 FARMER*, instead of complex three-dimensional structures, in type and number of components and shapes.

b. Separate/isolate FARMER* 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 FARMER* 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 FARMER* : Separation in space

Solution strategy for FARMER* : Improving attributes

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

a. Change FARMER*'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 FARMER* 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 FARMER*.

Separation principle for FARMER* : Separation by condition / Separation alternative

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

40. Composite Materials/ Conditions, Oper. IP (Pos.14):

a. Change from a uniform material, property, state, or condition in, or for, FARMER* , to a composite one, or vice versa.

Separation principle for FARMER* : Separation by condition

Solution strategy for FARMER* : Improving attributes

COMPLEMENTARY CONTRADICTION 2

Contradiction order wt.6

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

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

Parameter to attenuate or preserve: (-) 10. Force/ Intensity

TO ATTENUATE OR PRESERVE (UDE): FARMER has Less Force or impulse interacting with S2

Inventive principles IP(s) : [10,18,3,14]

10. Preliminary Action, Str. IP (Pos.1):

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

b. Pre-arrange FARMER* 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 FARMER* : Separation in time

Solution strategy for FARMER* : Improving attributes; Improving performance

18. Mechanical Vibrations/ Energy Variations, Tac. IP (Pos.16):

a. Move FARMER* by cycles with energies that activate it

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

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

d. Apply alternation of FARMER* or its functions.

Separation principle for FARMER* : Separation in time

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

3. Local quality, Str. IP (Pos.6):

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

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

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

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

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

Separation principle for FARMER* : Separation in space

Solution strategy for FARMER* : 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.13):

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

b. For the interaction between FARMER* 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 FARMER* 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, FARMER*.

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

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

Separation principle for FARMER* : Separation alternative

Solution strategy for FARMER* : Improving attributes; Improving if a solution has not yet emerged

COMPLEMENTARY CONTRADICTION 3
Contradiction order wt.8

Parameter to improve: (-) 14. Strength / Resistance
TO IMPROVE (UDE): FARMER has Less Strength or resistance interacting with S2
Parameter to attenuate or preserve: (+) 27. Reliability
TO PRESERVE (DE): FARMER has More Desired reliability to interact with S2
Inventive principles IP(s) : [11,3,0,0]
11. Beforehand Cushioning, Tac. IP (Pos.4):
a. Prepare emergency means, beforehand, to compensate for the relatively low reliability of FARMER*.
Separation principle for FARMER* : Separation in time
Solution strategy for FARMER* : Improving 7 quality factors (Quality, Reliability, Maintainability, Supportability, Human Factors, Safety, Security)

3. Local quality, Str. IP (Pos.6):

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

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

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

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

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

Separation principle for FARMER* : Separation in space

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

COMPLEMENTARY CONTRADICTION 4
Contradiction order wt.13

Parameter to improve: (-) 10. Force/ Intensity

TO IMPROVE (UDE): FARMER has Less Force or impulse interacting with S2

Parameter to attenuate or preserve: (-) 21. Power/ Energy per unit of time

TO ATTENUATE OR PRESERVE (UDE): FARMER has Less Power or energy per unit of time interacting with S2

Inventive principles IP(s) : [19,35,18,37]

19. Time-Varying Action/ Periodic or Pulsating, Str. IP (Pos.5):

a. Instead of using continuous action in, or for, FARMER*, , use time-varying, periodic, or pulsating actions.

b. If the action of FARMER* is already periodic, change the periodic magnitude or frequency.

c. Use pauses between impulses to perform a different action of FARMER*.

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

Separation principle for FARMER* : Separation in time

Solution strategy for FARMER* : Improving performance

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

a. Change FARMER*'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 FARMER* 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 FARMER*.

Separation principle for FARMER* : Separation by condition / Separation alternative

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

18. Mechanical Vibrations/ Energy Variations, Tac. IP (Pos.16):

a. Move FARMER* by cycles with energies that activate it

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

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

d. Apply alternation of FARMER* or its functions.

Separation principle for FARMER* : Separation in time

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

37. Useful Perceptible Change , Oper. IP (Pos.21):

a. Use state, dimension or condition changes occurring to FARMER*, because of a modification or application of an external or self-generated field, which is perceptible by and can influence to object (S2) with which it interacts.

The change may be permanent or variable in time.

(e.g., use field emissions, thermal expansion (or contraction) of materials, signals, etc.).

Separation principle for FARMER* : Separation in time

Solution strategy for FARMER* : Improving attributes

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

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

CONTRADICTION BETWEEN NEEDS TO SATISFY N° 1

Parameter to improve 27. Reliability

MEJORAR > FARMER tiene More Desired reliability to interact with S2

Parameter to preserve 33. Ease of operation

PRESERVAR > FARMER tiene más efecto deseable por párametro 33. Ease of operation

Inventive principles IP(s) : [27,17,40,0]

27. Cheap Short-Living Objects, Str. IP (Pos.26):

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

Separation principle for FARMER* : Separation in subsystem

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

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

a. Add or remove physical dimensions or fields of action of FARMER*.

b. Move FARMER* to a new dimension in space or performance field.

c. Use for FARMER* multi-story arrangement of objects instead of a single-story arrangement.

d. Tilt or re-orient FARMER*; lay it on its side.

e. Use another side of a given dimension or field of FARMER*.

Separation principle for FARMER* : Separation in space

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

40. Composite Materials/ Conditions, Oper. IP (Pos.14):

a. Change from a uniform material, property, state, or condition in, or for, FARMER* , to a composite one, or vice versa.

Separation principle for FARMER* : Separation by condition

Solution strategy for FARMER* : Improving attributes

CONTRADICTION BETWEEN NEEDS TO SATISFY N° 2

Parameter to improve 27. Reliability

MEJORAR > FARMER tiene More Desired reliability to interact with S2

Parameter to preserve 39. Productivity

PRESERVAR > FARMER tiene más efecto deseable por párametro 39. Productivity

Inventive principles IP(s) : [1,35,29,38]

1. Segmenting/ Integrating, Str. IP (Pos.19):

a. Divide FARMER* 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 FARMER* into a single entity..

c. Make FARMER* easy to disassemble or assemble.

d. Increase or reduce the degree of fragmentation or segmentation of FARMER*.

Separation principle for FARMER* : Separation in space / Separation in subsystem

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

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

a. Change FARMER*'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 FARMER* 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 FARMER*.

Separation principle for FARMER* : Separation by condition / Separation alternative

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

29. Controllable Soft Variables, Tac. IP (Pos.9):

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

b. Make easier FARMER* 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 FARMER* : Separation in time

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

38. Strong or Fast Reactions, Oper. IP (Pos.):

a. Apply strong and/or quick reactions to FARMER* (e.g., apply strong oxidants, sudden change.).

Separation principle for FARMER* : Separation by condition

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

CONTRADICTION BETWEEN NEEDS TO SATISFY N° 3

Parameter to improve 27. Reliability

MEJORAR > FARMER tiene More Desired reliability to interact with S2

Parameter to preserve 15. Duration of action of moving object

PRESERVAR > FARMER tiene más efecto deseable por párametro 15. Duration of action of moving object

Inventive principles IP(s) : [2,35,3,25]

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

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

b. Add new parts or properties to FARMER*.

Separation principle for FARMER* : Separation in space

Solution strategy for FARMER* : Improving attributes

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

a. Change FARMER*'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 FARMER* 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 FARMER*.

Separation principle for FARMER* : Separation by condition / Separation alternative

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

3. Local quality, Str. IP (Pos.6):

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

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

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

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

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

Separation principle for FARMER* : Separation in space

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

25. Self-service, Oper. IP (Pos.):

a. Make FARMER* serve itself by performing helpful auxiliary functions.

b. Use resources, energy or substances that are wasted or unused by FARMER*.

c. Incorporate resources and/or functions into FARMER* for self-service during operation.

Separation principle for FARMER* : Separation in subsystem / Separation alternative

Solution strategy for FARMER* : 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.

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