



**TRIZ in business: principles of creative thinking in engineering may be useful for entrepreneurs**  
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**Michal Jasienski, PhD**  
***Technopark Gliwice, Poland***



**Genrikh Saulovich Altshuller (1926-1998)**

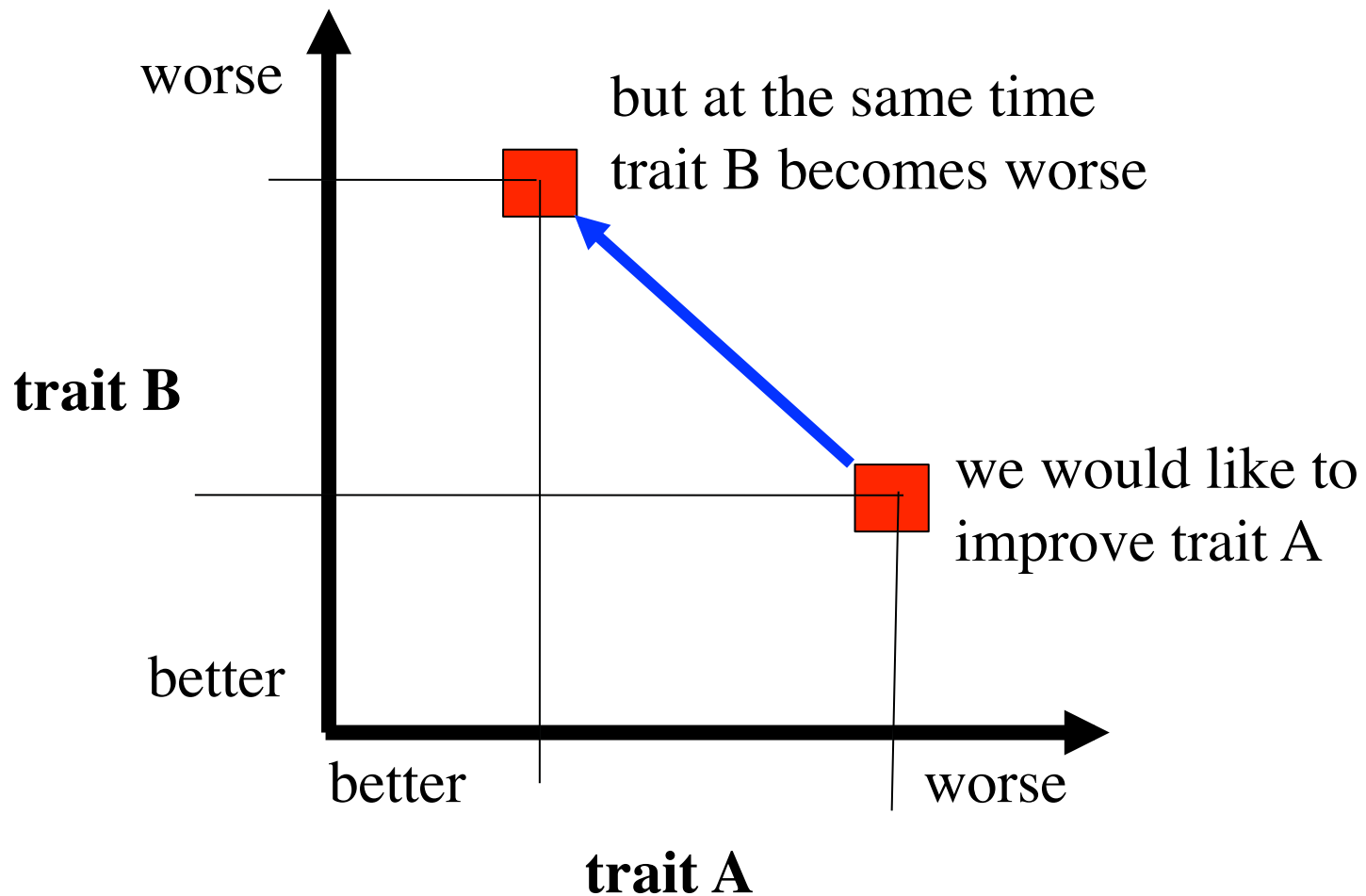
**Теория решения  
изобретательских задач**

# trade-offs: length vs thickness

## High-Definition Multimedia Interface

- all-digital audio/video interface capable of transmitting uncompressed streams
- *“A reported problem with HDMI is the maximum cable length. As with all cables, signal attenuation becomes too high at a certain length... signal performance degrades above a cable length of about 5 meters.”*
- How to solve the problem?
- increase the thickness of the copper cables = decrease impedance
- use fiber optic cable instead of standard copper

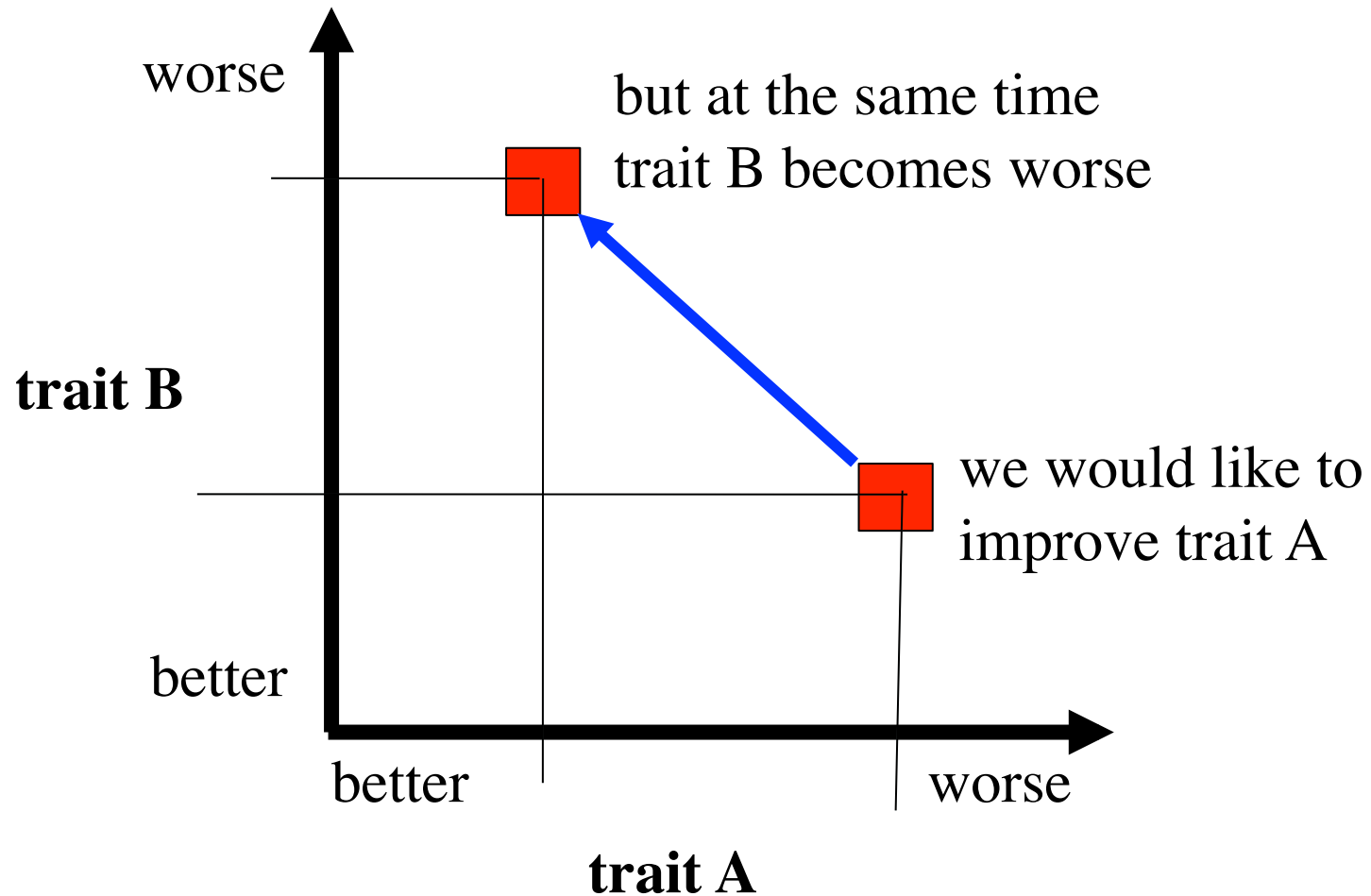
# technical contradiction



TRIZ przesuwaa linie kompromisu (antynomii) w kierunku poczatkku

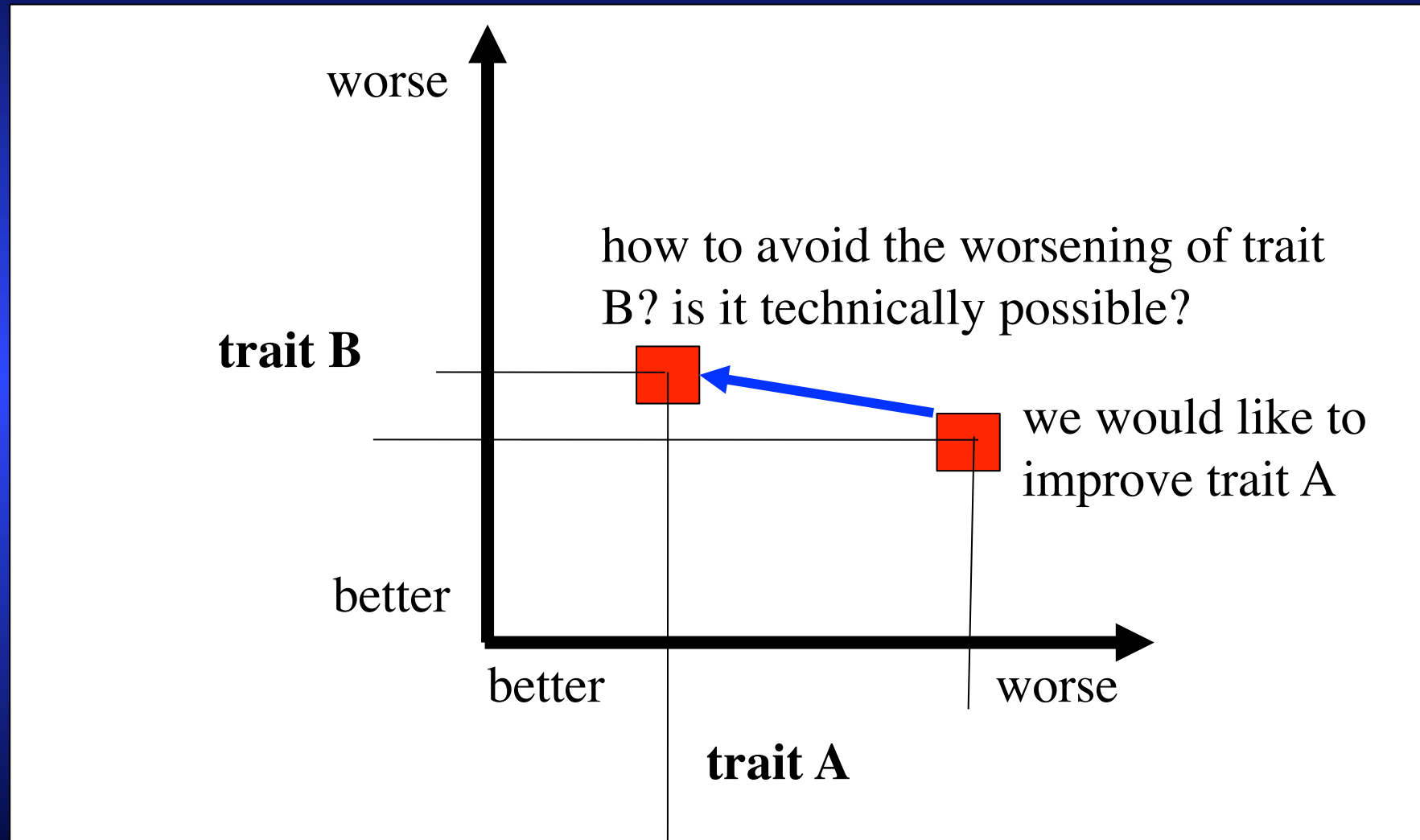
# technical contradiction

A: resistance to bending, B: weight



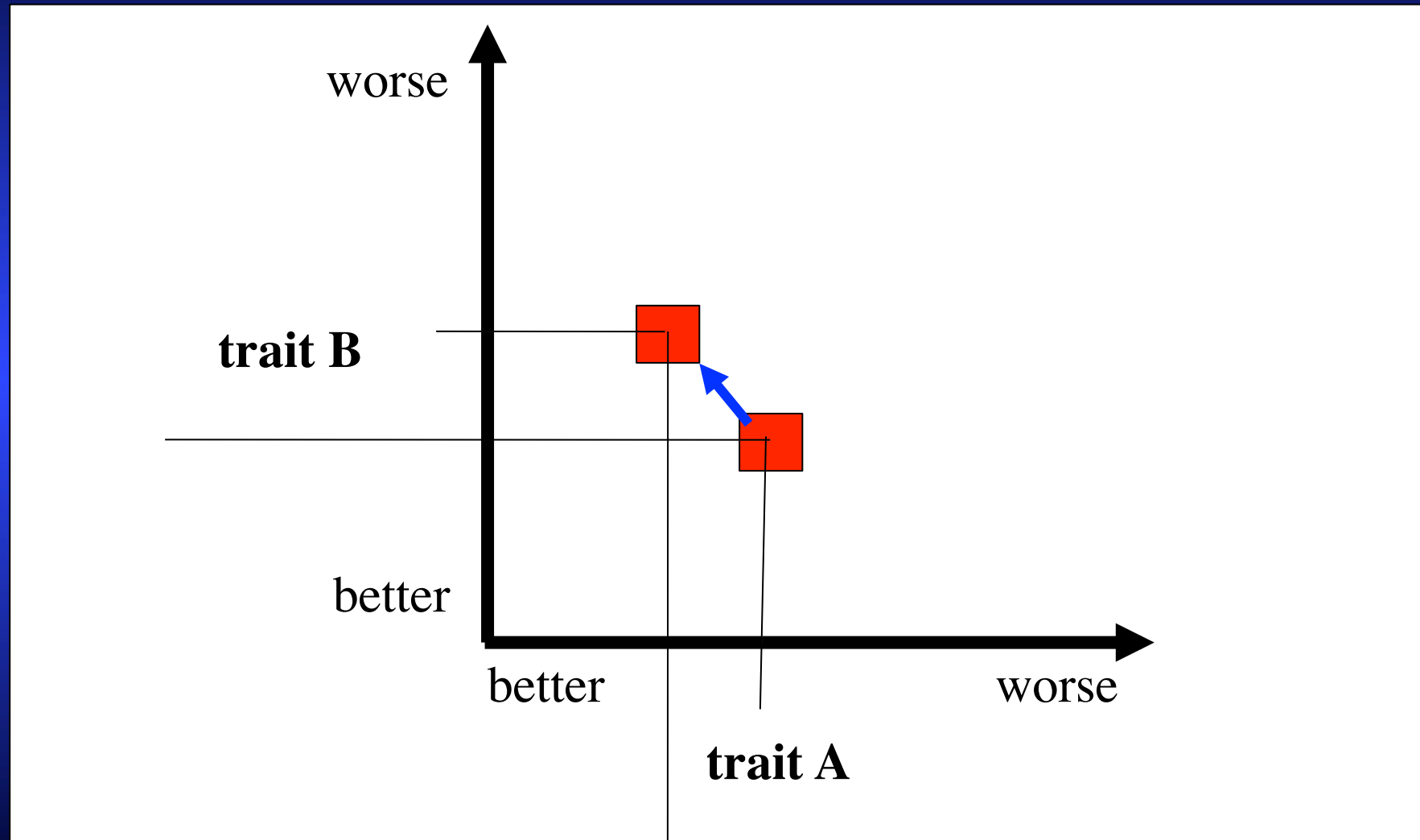
TRIZ przesuwaa linie kompromisu (antynomii) w kierunku poczatk

# technical contradiction = trade-off



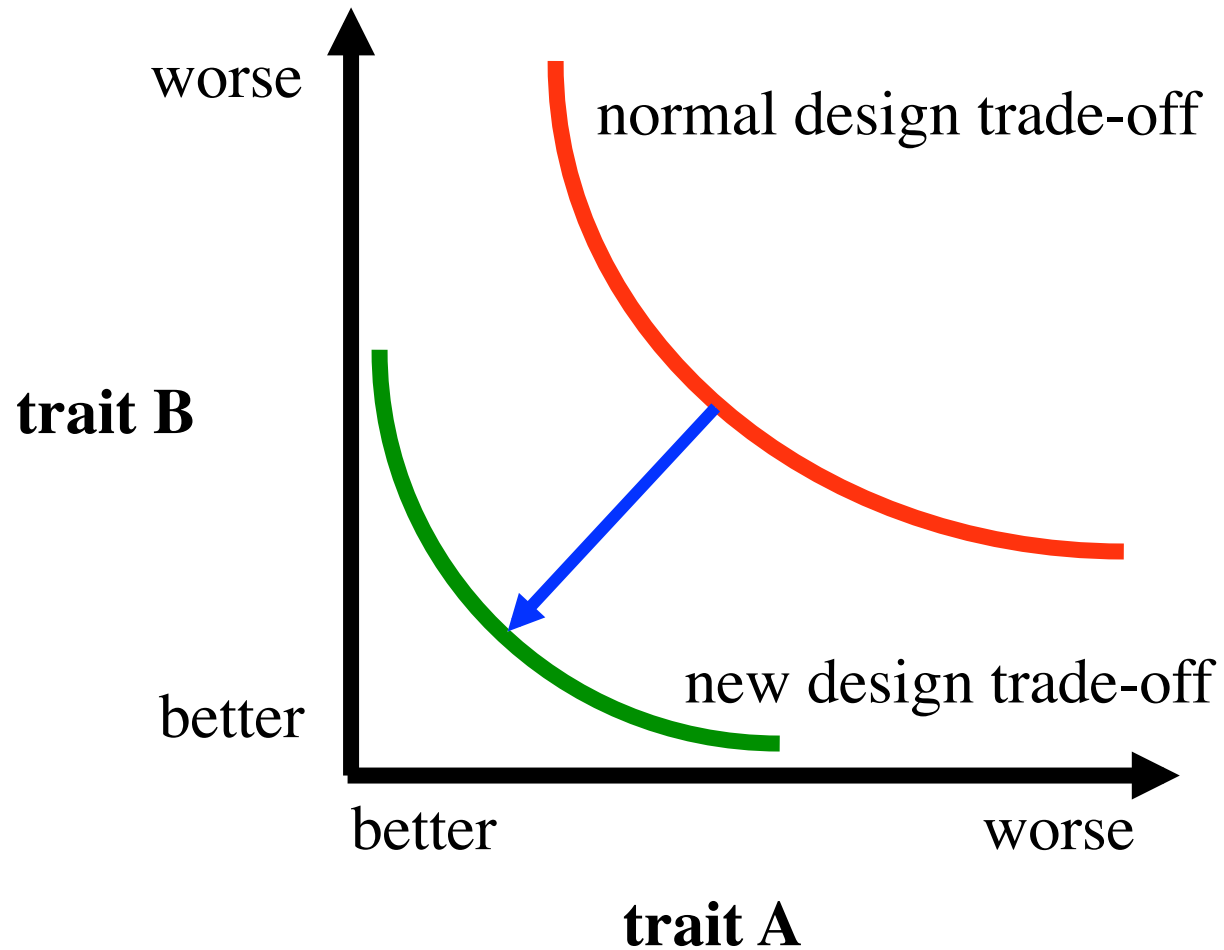
TRIZ przesuwaa linie kompromisu (antynomii) w kierunku poczatk

# technical contradiction



TRIZ przesuwaa linie kompromisu (antynomii) w kierunku poczatk

# technical contradiction



TRIZ przesunęła linie kompromisu (antynomii) w kierunku początku



# The 39 Engineering Parameters

1. Weight of moving object
2. Weight of nonmoving object
3. Length of moving object
4. Length of nonmoving object
5. Area of moving object
6. Area of nonmoving object
7. Volume of moving object
8. Volume of nonmoving object
9. Speed
10. Force
11. Tension, pressure
12. Shape
13. Stability of object
14. Strength
15. Durability of moving object
16. Durability of nonmoving object
17. Temperature
18. Brightness
19. Energy spent by moving object
20. Energy spent by nonmoving object
21. Power
22. Waste of energy
23. Waste of substance
24. Loss of information
25. Waste of time
26. Amount of substance
27. Reliability
28. Accuracy of measurement
29. Accuracy of manufacturing
30. Harmful factors acting on object
31. Harmful side effects
32. Manufacturability
33. Convenience of use
34. Repairability
35. Adaptability
36. Complexity of device
37. Complexity of control
38. Level of automation
39. Productivity

# matrix

Undesired secondary effect	1 Weight of moving object	3 Length of moving object	37 Complexity of control	38 Level of automation	39 Productivity
Feature to improve					
1 Weight of moving object	xxx				
3 Length of moving object		xxx			
37 Complexity of control			xxx		
38 Level of automation				xxx	
39 Productivity	<b>principles 20, 24, 26, 34</b>				xxx

# 40 Inventive Principles (TRIZ)

- 1. Segmentation 2. Taking out 3. Local Quality 4. Asymmetry 5. Merging 6. Universality 7. 'Nested doll' 8. Anti-weight 9. Preliminary anti-action 10. Preliminary action 11. Beforehand cushioning 12. Equipotentiality 13. 'The other way around' 14. Spheroidality 15. Dynamics 16. Partial or excessive actions 17. Another dimension 18. Mechanical vibration 19. Periodic action 20. Continuity of useful action
- 21. Skipping 22. 'Blessing in disguise' 23. Feedback 24. 'Intermediary' 25. Self-service 26. Copying 27. Cheap short-living 28. Mechanics substitution 29. Pneumatics and hydraulics 30. Flexible shells and thin films 31. Porous materials 32. Color changes 33. Homogeneity 34. Discarding and recovering 35. Parameter changes 36. Phase transitions 37. Thermal expansion 38. Strong oxidants 39. Inert atmosphere 40. Composite material

# how to use them?

- improvise
- fantasize
- treat them as metaphors of your specific business challenges
- or as useful ideas for your engineering work
- and remember: this is a heuristic method
- it only increases a chance of finding a good solution

# no. 1– Segmentation

Divide into modules or make more modular

## *in Engineering*

- Make an object easy to disassemble.
- Modular furniture


## *in Business & Management*

- Empowering employees introduces „segmentation“ into decision making in the organization
- Divide price into monthly payments
- When the organizational structure is no longer allowing sufficient flexibility, the existing departments or teams should be split into smaller units.

# no. 2 – Extraction (Taking out)

Extract features or parts that are either essential or cause problems

## *in Engineering*

- Use the sound of a barking dog, without the dog, as a burglar alarm 
- Use fiber optics or a light pipe to separate the hot light source from the location where light is needed

## *in Business & Management*

- The „home office“: extract expensive space to house their physical bodies while they carry out their duties
- Extract distance and separation from relationships by offering customer support 24/7
- Extracting functionalities from hardware to software: “Indigo”

# function “extracted” from hardware

- Silicon Graphics  
“Indigo” workstation  
(1991)

# no. 11– Beforehand Compensation

Be ready with emergency means before they are necessary

## *in Engineering*

- Seat-belts and air-bags
- Back-up parachute

## *in Business & Management*

- Making „Frequently Asked Questions“ available in any form to the customers, anticipating their needs
- Assemble a pool of free-lance collaborators who are ready to step in at any time, e.g. during high flu-season absenteeism period
- In negotiations, have your BATNA (best alternative to a negotiated agreement) ready



# no. 13 – Do it in Reverse

Question the status quo by inverting, turning upside down, or moving what was fixed

## *in Engineering*

- To loosen stuck parts, cool the inner part instead of heating the outer part
- Moving sidewalk with standing people
- Treadmill (for walking or running in place)
- Empty grain from containers (ship or railroad) by inverting them

## *in Business & Management*

- To stimulate sales of luxury goods, increase the prices instead of lowering them
- Instead of minimizing conflicts among employees with regulations and counseling, stimulate creative conflict
- The idea of assembly line is based on making workers immobile and the products **mobile** (Lucy and chocolates or Chaplin *Modern times*)

# no. 14 – Spheroidal or curved

## Switch from rectilinear or angular to ball-shaped solutions

### *in Engineering*

- Replace wringing clothes to remove water with spinning clothes in a washing machine
- Ball point and roller point pens for smooth ink distribution
- Use arches and domes for strength in architecture

### *in Business & Management*

- Circular arrangement of offices = egalitarian organizational culture
- Put office furniture on wheels (and better yet – on spherical casters)
- Round-table discussions for employees = equal importance of contributions from everyone
- Rotate jobs, perks and privileges among employees.

# no. 27 – Cheap disposables

Each application of this rule should be preceded by cost-benefit analysis, to justify the business logic of it

## *in Engineering*

- Reduce costs of cleaning by using disposable cups and utensils
- Use shrink-wrap plastic foil to prepare items for shipping, rather than relying on more permanent containers

## *in Business & Management*

- Deliver software update to customers via downloadable virtual „disks“ which are put to trash after the software has been installed
- Rely on computer simulation to create virtual, „disposable“, representations of the actual objects  
Use temporary offices, rented by the hour, instead of expensive, permanent locations. Use temporary workers, hired for short-term contracts.
- Replace permanent physical objects (screens, keyboards) with holographic projections which are „disposed of“ after use.

# no. 29 – Pneumatics and Hydraulics

Soft and flowing is better than hard and fixed

## *in Engineering*

- Use gas and liquid parts of an object instead of solid parts (e.g. inflatable, filled with liquids, air cushion, hydrostatic, hydro-reactive): comfortable shoe sole inserts filled with gel

## *in Business & Management*

- Software-based solutions, rather than implementation in hardware, may result in substantial cost reduction for customers, easier (even remote) maintenance and upgrade schemes
- Soft skills, software and intangible resources (captured by the metaphor of „pneumatics“) may be more important, i.e. effective and long lasting, than tangible infrastructure and hardware
- Liquid or flexible, rather than fixed-schedule salary, may be more effective in motivating employees

# no. 31 – Porous Materials

Add pores or holes, real or metaphorical, to physical objects or your action

## *in Engineering*

- Drill holes in a structure to reduce the weight
- If an object is already porous, use the pores to introduce a useful substance or function

## *in Business & Management*

- Make company's organizational structure „porous“ by drilling holes in it, i.e. creating empty niches, **with no job descriptions**. Those could be filled with free-lancers or intrapreneurs (who are employees of the company) who could be assigned various jobs
- Make holes in the glass ceiling which prevented women from achieving higher status in the corporate hierarchy
- Porous nature of the interface with customers should let them in easily (with free membership cards and easy account creation), but should not let them go (with loyalty programs and „fine print“ rules).

# no. 39 – Inert Atmosphere

Sometimes it is more desirable when the conditions are not „exciting“, but quiet and neutral

## *in Engineering*

- Replace a normal environment with an inert one
- Prevent degradation of a hot metal filament by using an argon atmosphere

## *in Business & Management*

- Conduct creativity sessions in places other than work offices, to avoid environment filled with distractions or intense emotions, e.g. rent a quiet („inert“) conference room in a nearby hotel
- Organize mock presentations before business meetings or academic conferences in front of a „neutral“ (i.e. noncompetitive, impartial) audience composed of friends, neighbors, or students.
- Invite neutral and quiet moderators to potentially volatile debates.

# no. 40 – Composite materials

Nonuniformity (heterogeneity) of the material/object may bring about desirable characteristics

## *in Engineering*

- Change from uniform to composite (multiple) materials.
- Composite epoxy resin/ carbon fiber golf club shafts are lighter, stronger, and more flexible than metal

## *in Business & Management*

- Recruit team members who have heterogeneous educational profile, i.e. obtained degrees in very different fields, such as biology PhD and MBA, art and engineering etc. Their educational backgrounds are „composites“ and the profile of the entire team becomes a composite of various competencies