



Investigation of principle 13 via function and resources approach

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Full text of presentation located in <http://www.triz-solver.com/>

abstract

- ▶ There are 4 levels of education in TRIZ culture : level 1–2–3–4. Accordingly, there are 4 different depths for consideration of every tool of problem solving. There is description of 40 principles for level 4. This article shows consideration of **principle 13. 'The Other Way Around'** regarding to our knowledge about function and resources. Before application of resources and functions as tools for inspection, we had only 3 recommendation by Genrich Altchuller.
 1. Invert the action(s) used to solve the problem (e.g. instead of cooling an object, heat it)
 2. Make movable parts (or the external environment) fixed, and fixed parts movable.
 3. Turn the object (or process) 'upside down'.

- ▶ After application of popular TRIZ tools we can consider several additional mechanisms.
 4. **function** : “move” pull or push, 5. **function** : “add” or “ remove” substances or fields, 6. **space**: front – back, 7. **space**: inside– outside, 8. **space**: bottom–top, 9. **surface** : convexity – deepening , 10. **substances**: A(B) or B(A) , 11.**time**: day – night, 12. **time**: sequence of operation in manufacturing or business, 13. **strategy of thinking in invention process** : tool AFD by Boris Zlotin, 14. **strategy of thinking in invention process** : feature transfer by Vladimir Gerasimov and Simon Litvin: $A + B \neq A + B$. We can use also several combinations between these 14 mechanisms. Final conclusion: we can use TRIZ to develop tools of TRIZ.

- ▶ *Keywords: inventive principles, function, function oriented search, resource of time, space, substance, field, merging of needs, technology of creative thinking, AFD, feature transfer*

Classical interpretation

<http://rus.triz-guide.com/assets/files/aitshuller/technique-1-2.asp.htm>

ПРИЕМ 13
ПРИНЦИП "НАОБОРОТ"

а) Вместо действия, диктуемого условиями задачи, осуществить обратные действия (например, не соскребать объект, а нагревать).
б) Сдвигать движущуюся часть объекта (или внешней среды) неподвижной, а неподвижную — движущейся.
в) Перевернуть объект "верхом ногам".

ПРИМЕРЫ
Авторское свидетельство № 124444. Способ виброобработанной очистки металлоповерхости в абразивной среде, отличающийся тем, что, с целью улучшения процесса очистки, движения вибрации сообщают обрабатываемой детали.

Авторское свидетельство № 109942. Это изобретение решает важную проблему отливки крупногабаритных тонкостенных деталей. При отливке чашки дельтаид калателью, чтобы металл поступал в форму сверху и затвердевание шло снизу (то есть металл в форму ("дождевой" способ) допустимо с высоты не более пятнадцати сантиметров, иначе металл сползет или газы. А как быть, если форма имеет высоту два-три метра? Если подавать металл снизу, то первые порции его затвердеют, не успев подняться к верхней части формы.

Изобретатель решил эту задачу просто и изящно: металл идет по трубкам, опущенным со дна дельтаидной формы. Там, где заливается форма движется вниз, и, таким образом, сверху порция металла подается именно туда, где она должна вылиться (см. Рис. 16).

Рис. 16
Принцип "наоборот": в отличие от обычного способа движется форма, а поступающий в нее металл неподвижен.

Авторское свидетельство № 109942. Это изобретение решает важную проблему отливки крупногабаритных тонкостенных деталей. При отливке чашки дельтаид калателью, чтобы металл поступал в форму сверху и затвердевание шло снизу (то есть металл в форму ("дождевой" способ) допустимо с высоты не более пятнадцати сантиметров, иначе металл сползет или газы. А как быть, если форма имеет высоту два-три метра? Если подавать металл снизу, то первые порции его затвердеют, не успев подняться к верхней части формы.

Лишь когда осуществилось то, что делалось металл было неподвижной. Зато все наоборот: движется дельтаид и в нее металл остается неподвижным. Это "совместить неизвестное": плавность заливки затвердевание металла снизу вверх, как при литье способом.

Resources of fields
Drying of clothes in the frost
Drying via heating
Drying via frosting

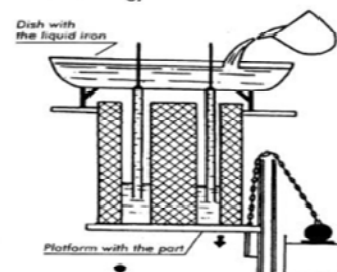
Resources of space
Similar PC and Similar Solution

Definition by Generic Altshuller

13. Do It in Reverse

Do It in Reverse

A. Instead of the direct action dictated by a problem, implement an opposite action (i.e., cooling instead of heating).




C. Turn an object upside-down.

An electric burner is installed in the cover of a frying pan so that cooking may be done from two sides at the same time.

13
"Now you are posing correctly!"

Definition by Generic Altshuller

B. Make the moveable part of an object, or outside environment, stationary — and the stationary part moveable.



Classical recommendation

13. OTHER WAY ROUND (반전의 원리)

а) 정의된 작용 대신 반대되는 작용을 적용한다.
б) 움직일 수 있는 물체를 고정하거나 고정된 물체를 움직일 수 있도록 한다.
с) 물체를 거꾸로 뒤집는다.

Abrasive cleaning of parts by vibrating the parts instead of the abrasives

Definition by Generic Altshuller

old recommendation for Principle 13

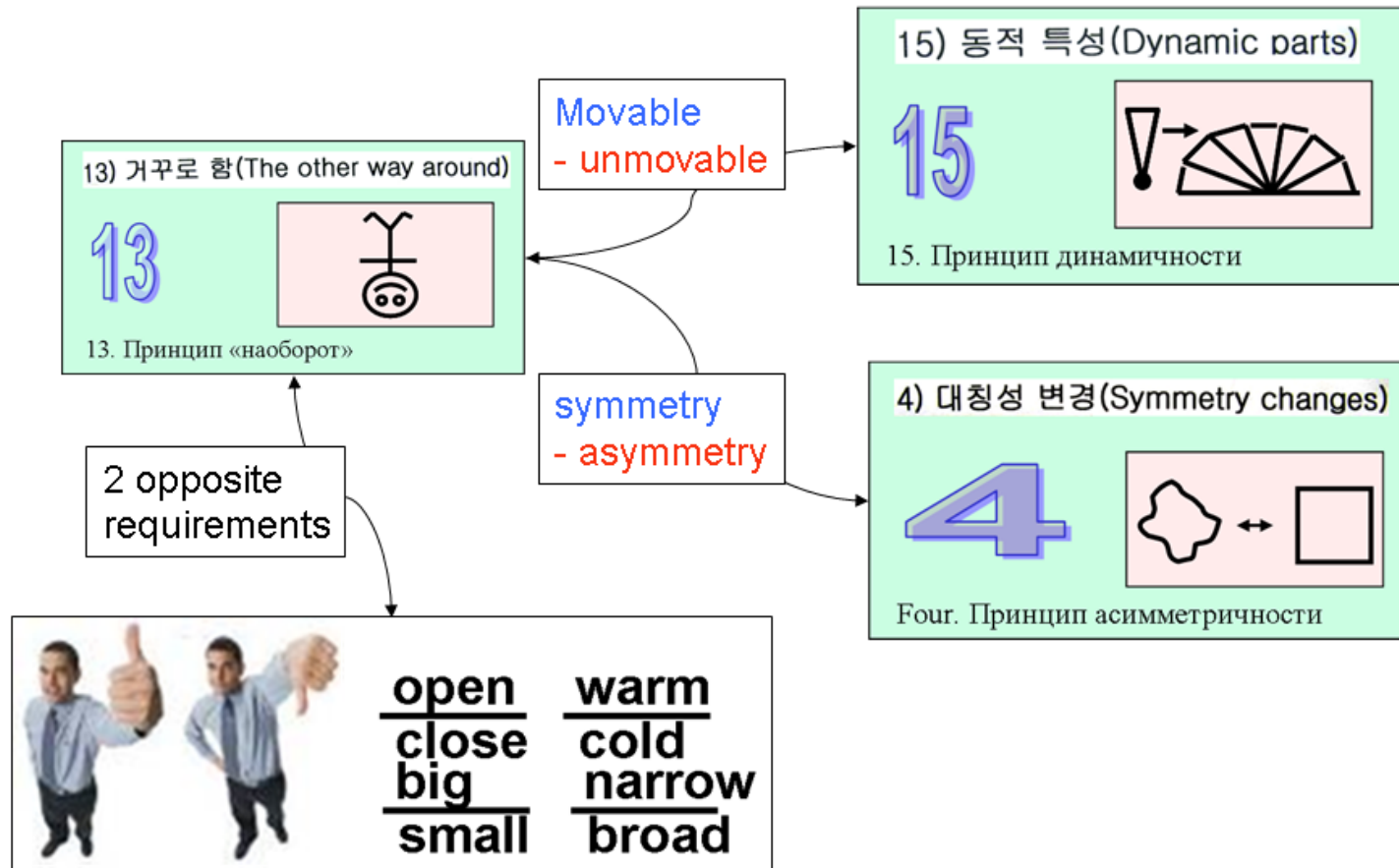
functions: Heating-cooling 1, Move - not move (hold) 2, ?

bottom - top 3

Resources of space
Similar PC and Similar Solution

Definition by Generic Altshuller

Crossings with another principles

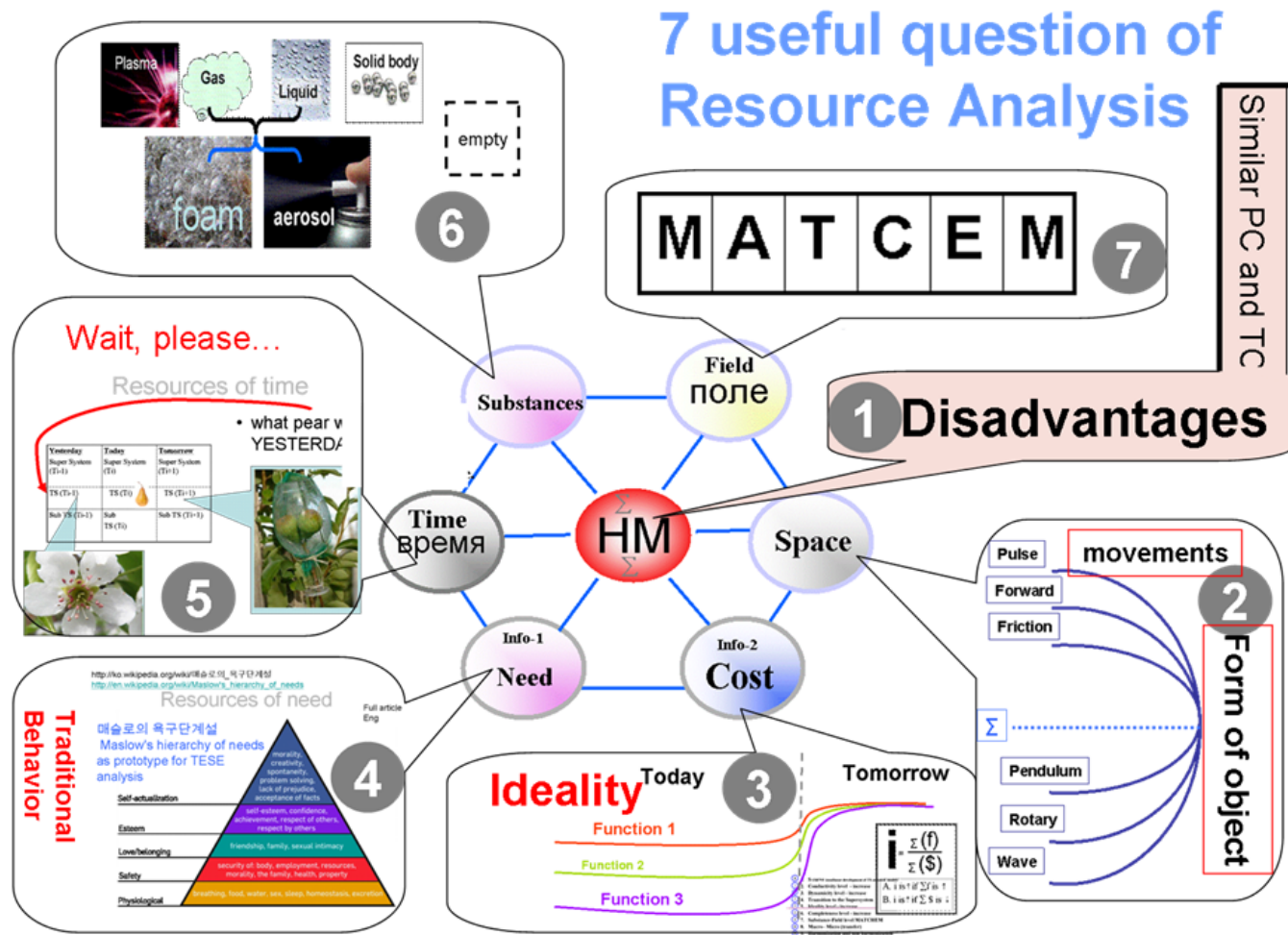


Q: Why principle 13 is important?

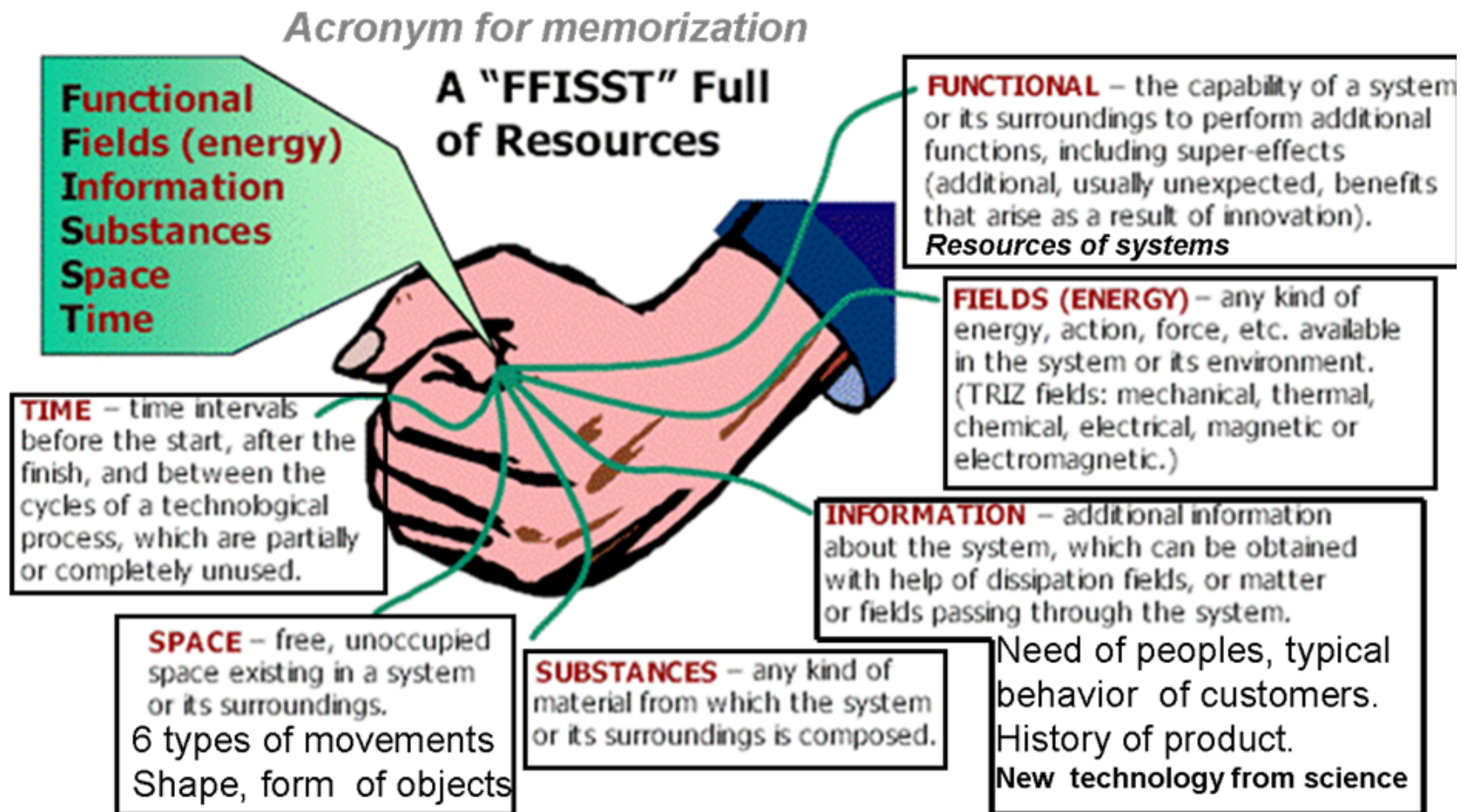
Answer: high level of applicability

Typical problem disadvantages	resource	Trends	helper in 40 principles family
Small capacity	System level, time, need, cost	S curve model (mono- bi- poly) consider non linear process of development	5,6,7,20, 38,39,40
small reliability of system, big tiredness	substances and field	Completeness consider increase of part until to robotic system	9,10,12,23,32,34,37, 38
High cost of result	Type of movement space	Conductivity increase different ways for increase of productivity	4,9,12, 14,15, 17, 18,21,25
small amount of function, big amount of parts	need, cost	Ideality consider increase amount of function and decrease of spending materials/ time, movement	4,5,6,7,8,9,10,11,16, 19,20,24,26,27,32
Expensive resources. Old (perfect) system	Resources of need or cost or time	Transfer to SS consider contact with super system	2,6,11,13,24,26,38
Size of system before application	space, substance, field	Dynamicity consider bond between parts of system	7,13, 15,17, 19,25,29,30, 32 ,35-8
Small efficiency	Field and source of energy	MATCHEM consider probability of change type of energy for process	5,6,8,9,10,19,22,23, 24, 28,32,34,36,37
Cost reduction, old system	substances	Macro→ micro consider every condition of substances	1,5,6,23,27,28,29,31, 32,34,35,36,38,39,40
Small convenience	Behavior of peoples	Harmonization consider increase level of conveniences	1,2,3,7,9,10,12,23,24 ,33,39

we can use resources analysis approach for investigation about additional mechanisms for execution of principle 13



Definition of resources by TRIZ Master Boris Zlotin (USA) and TRIZ Master Yury Danilovsky (S.Korea)



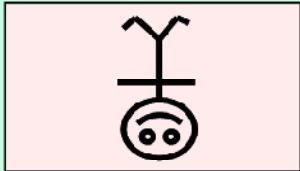
We can use for investigation approach of “function”

<p>Move, pull, push, revolve, propel, tir, jump, shove, jostle, poke, jab, insert, put, bump, hustle</p> <p>Двигать, перемещать, толкать, вращать, вставлять, ударять, шевелить, трясти, нажимать, размешивать, тянуть, стукнуть, ставить, помещать, бросать, излучать</p> <p>이동시키다, 움직이다. 당기다/밀다, 회전시키다, 추진하다. 쏘다, 던지다, 밀치다, 치르다, 치고 빠지다, 넣다, 놓다, 부딪히다, 흔들다.</p> <p>เคลื่อนย้าย, ค้าง, ผลัก, หมุนไปรอบๆ ขับเคลื่อน กระโดด ซุก กระแทก โผล่ แทง แทะ/ใส่/จน/เขี่ย</p>	<p>Add, pour, infuse, inject, blast, append, supplement, throw in, tag, top up, tack, eke, stick, weld, sew</p> <p>Добавлять, присоединять, прикреплять, доливать, досыпать, наполнять, приметать, пришивать, приклеивать, приваривать,</p> <p>접착제, 용접, 타하다, 덧붙이다. 추가하다; 붓다, 우리다, 집어넣다, 매달다, 던져넣다, 꼬리표를 붙이다, 채우다 (임상) 바다, 연장해붙이다, 접착해붙이다, 용접하다, 바느질해붙이다.</p> <p>เติม เมา ใส่นี้ ระเบิด ดมพ่น เลறி มโยน แพ้ กวางไว้ ด้า นบน กัด ดติ ดเห็ อมเย็บ</p>	<p>Extract, dig, delete, cut, remove, eliminate, purge, expel, exclude, filter, move away, prune, amputate, elicit, retrieve, recover, derive, draw, unearth</p> <p>Удалять, стирать, фильтровать, впитывать, очищать, исключать, вычёркивать, извлекать, добывать, выкапывать, экстрагировать, выпаривать, выталкивать, обрезать,</p> <p>제거하다. 없애다; 추종하다, 파내다, 자우다, 삭제하다. 청소하다, 추방하다, 제외시키다, 걸러내다, 치워버리다, 가지치다, 잘라내다.</p> <p>สารสกัด ดึง ดลบตี ดลบกำ จั ดลั้ง วง ขี้ บได้ ยกเว้น ดั กรอง ข้าย ออกไปตี ดลั้ง วง เร็ ยก กู้ คี นมา วาด พบ</p>
<p>Hold, fix,, retain, maintain, withhold, hold down, deter, deduct, restrain, detain, stop, confine</p> <p>Удерживать, держать, хранить, сохранять, задерживать, фиксировать, останавливать</p> <p>고정하다, 지지하다. 잡다, 포함(내포,보관)하다. 주지않다. 가두다, 정지시키다. 국한시키다.</p> <p>ถือ อ แก้ว ไข เก็ บจั กษารั้ง บดั างไว้ ยั บยั ง หั กัก กหยุด ดั้ง ดั้ง น</p>	<p>Deflect, reflect, change direction of movement, protect, mirror, agitation of some substances or fields, focus, repel, repulse, beat back, parry</p> <p>Изменять направление движения, отражать, предохранять от удара, создать турбулентность, реверберировать, воздействовать, отклонять, отталкивать, отбрасывать, препятствовать, преграждать,</p> <p>충격 보호하고 난류를 생성, 영향을 거부 할 수 격퇴, 굴절시키다, 운동방향을 바꾸게 하다; 반사시키다, 난류를 만들다, 밀어내다, 집중시키다, 방사시키다, 막아(뚫겨)내다.</p> <p>หันเหความสนใจ ดั้ง อนุให้ เห็ นตั้ง เป็ล ยน หั ดทางของการเคสิ อนุไหวกระจกการกั อกวนของดลางบงอัย วงหรี อหลายเขต ขี้ อมู ดมู งเน็ นขี้ บได้ ตี กดั บปี ดปี อง</p>	<p>Transform* (change of matter), convert, shatter, disintegrate, crush down, heat, warm, hot, calornfy, cold, froze.</p> <p>Преобрацать - Изменять параметры агрегатных состояний вещества по классификации В.Злотина MATXEM</p> <p>Расстигивать, деформировать, смять, разрушать, раздробить, молоть, разбивать, растереть в порошок, превратить в пудру, нагревать, плавить, охлаждать, таять, возгонять, конденсировать, окислить, восстановить, растворить, наэлектризовать, заземлить, намагнитить, размагнитить, фокусировать</p> <p>바꾸다. (성질을) 변화(변환)시키다, 변형시키다. 무수다, 놀러 무수다, 가열하다, 냉각시키다, 얼리다. 잡아늘리다, 녹이다, 증발/승화시키다, 압축/응축시키다, 산화시키다, 자화시키다 등</p> <p>เป็ล ยนแปลงปี นบี่ สลาย บคชยี่ สงควานรั อนุบอ์ อนุ อควานรั อนุเย็ นแซ เห็ งเห็ ยกคี่ นโซลู ชั นไฟฟ้ างดิ น,แม เห็ล ก. (by Boris Zlotin "MATCHEm")</p>

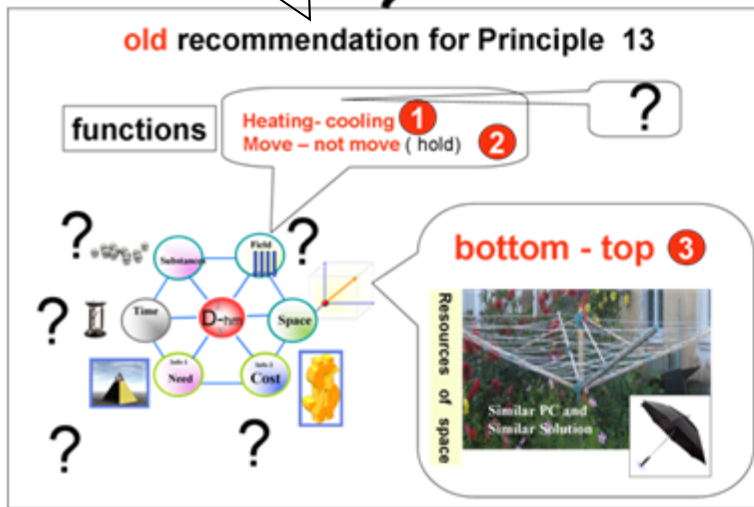
Navigation system for inspection of principle 13

13) 거꾸로 함(The other way around)

13



13. Принцип «наоборот»



New additional mechanisms

Legend: F – function, R - resources

Resources of space

13) 거꾸로 함(The other way around)
 13. Принцип «наоборот»

Наружная часть объекта → **The outside of object**

→ **The inside of the object**

Внутренняя часть объекта

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Inside – outside direction and opposite approach

1936 spring-motor-driven 78 rpm acoustical (non-electronic) gramophone

"electrical" RECORDING

Hard disk by computer

- Function: "to read of information" and principle 13

Resources of space

push
hold open

- Cover of container is "plate's springs" (Belleville springs)

Resources of space

13) 거꾸로 함(The other way around)
 13. Принцип «наоборот»

Наружная часть объекта → **The outside of object**

→ **The inside of the object**

Внутренняя часть объекта

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Inside – outside regarding function "heating"

13) 거꾸로 함(The other way around)
 13. Принцип «наоборот»

Наружная часть объекта → **The outside of object**

→ **The inside of the object**

Внутренняя часть объекта

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INTAKE
COMPRESSION
EXHAUST
IGNITION

- Internal combustion engine 내연 기관
- The Wankel cycle. The shaft turns three times for each rotation of the rotor and once for each orbital revolution around the eccentric shaft.


Stirling engine
 스티어링 엔진

outside

inside

http://en.wikipedia.org/wiki/Stirling_engine
http://en.wikipedia.org/wiki/Internal_combustion_engine
http://ko.wikipedia.org/wiki/%EC%A4%ED%84%B8%EB%A7%B1_%EC%97%94%EC%A2%84


Inversion in surface



Resources of substances

13) 거꾸로 함 (The other way around)

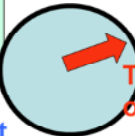
13



13. Принцип «наоборот»

Наружная часть объекта →

The outside of object

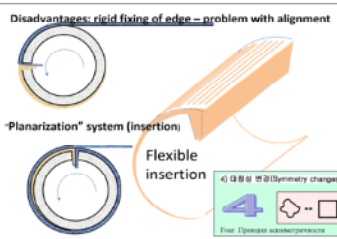


Внутренняя часть объекта
The inside of the object

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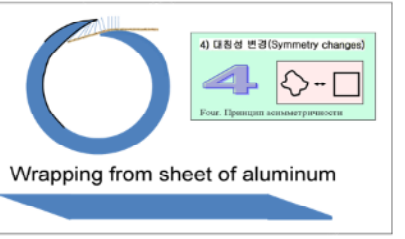
Disadvantages: rigid fixing of edge – problem with alignment



“Planarization” system (insertion)

Flexible insertion

4) 대칭성 변경 (Symmetry changes)
Four. Принцип симметричности




4) 대칭성 변경 (Symmetry changes)
Four. Принцип симметричности

Wrapping from sheet of aluminum


Analogy from another industry


13) 거꾸로 함 (The other way around)

13





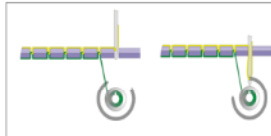
13. Принцип «наоборот»








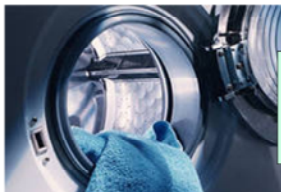
surface: Convexity – deepening

In front of object in the back of object regarding to “function hold substance”

mobile - fixed



Resources of function

Clothes is move for washing

13) 거꾸로 함 (The other way around)

13




13. Принцип «наоборот»

Clothes is fixed for washing


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Steam cleaning machine



Ion-cleaning machine




Steam cleaning machine



Ultrasonic Washing machines

Загружает белье в нейтральный раствор

mobile - fixed Resources of function



The photo moves

Photo is move for drying

13) 거꾸로 함(The other way around)
13. Принцип «наоборот»

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Photo is fixed for drying

mobile - fixed



vinyl record moves

vinyl record is move for playing

13) 거꾸로 함(The other way around)
13. Принцип «наоборот»

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vinyl record is fixed for playing

The photo is motionless




Resources of function

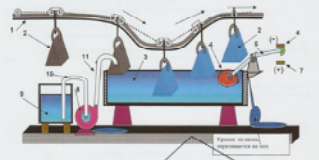
New invention



<http://www.capa.me/68489-void-voidokhnul-novuju-zhizn-v-starye-plastinki.html>

Paint dipping

mobile - fixed



object is move for coloring

13) 거꾸로 함(The other way around)
13. Принцип «наоборот»


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object fixed for coloring

<http://www.methodolog.ru/node/261>

mobile - fixed

Resources of function



13) 거꾸로 함(The other way around)
13. Принцип «наоборот»

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Resources of substances and gravity field




Use resources of information about mechanical inertia



Move the bottle



Move the lid

Resources of field

13) 거꾸로 함 (The other way around)
 13
 13. Принцип «наоборот»

Resources of function

Change colors

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13) 거꾸로 함 (The other way around)
 13
 13. Принцип «наоборот»

Resources of substances

A(B) and B(A) regarding to function "add substance"



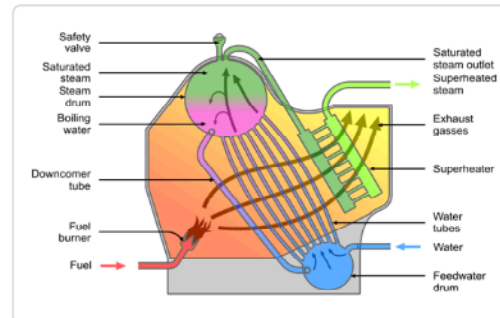
- There is opportunity for two substances and two colors in new design of pencil.
- Substance A can have dark color, substance B can have light color.

Resources of substances

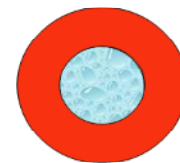
Resources of space

A(B) and B(A) regarding to function "heating"

http://en.wikipedia.org/wiki/Water-tube_boiler



water tube boiler



Heater located is outside

A water tube boiler is a type of boiler in which water circulates in tubes heated externally by the fire. Fuel is burned inside the furnace, creating hot gas which heats water in the steam-generating tubes. In smaller boilers, additional generating tubes are separate in the furnace, while larger utility boilers rely on the water-filled tub

Resources of substances

Push and pull in transport (behind – the front)

aerosani



The **RF-8**, a smaller WWII model powered by an inexpensive automotive engine 1903-1980

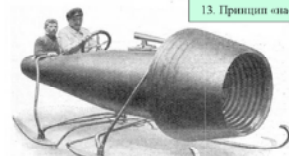
Airboat



The Army Corps of Engineers uses an airboat to collect herbicide-resistant hydrilla from Lake Seminole in northern Florida

<http://en.wikipedia.org/wiki/Aerosani>
<http://en.wikipedia.org/wiki/Airboat>

aerosani



<http://ru.wikipedia.org/wiki/%D0%BA%D0%B0%D1%80%D1%81%D0%BC%D0%B0%D0%BB>

1911키릴 블라디미로비치 로마노프
 Cyril Vladimirovich, Grand Duke of Russia



<http://alkatrion.com/?p=14583>

13) 거꾸로 함(The other way around)
 13

13. Принцип «заборот»

Push and pull in transport (behind – the front)

Aero car



<http://zabarankoi.ru/node/8409>

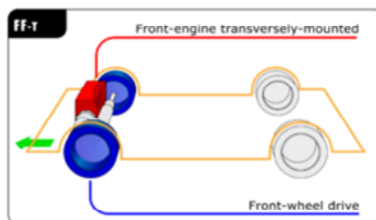
13) 거꾸로 함(The other way around)
 13

13. Принцип «заборот»

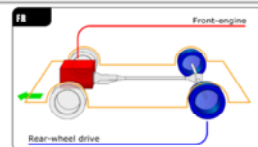
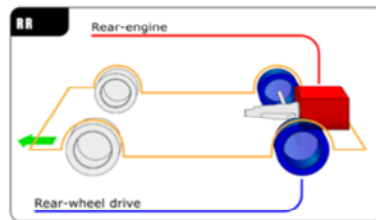


Push and pull in transport (behind – the front)

Automobile layout



http://en.wikipedia.org/wiki/Automobile_layout



13) 거꾸로 함(The other way around)
 13

13. Принцип «заборот»

Resources of space

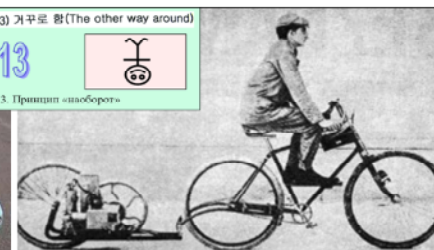


Push or pull?



13) 거꾸로 함(The other way around)
 13

13. Принцип «заборот»



GEN3 PARTNERS
 KOREA
www.gen3.co.kr/
www.triz-solver.com





Resources of function

Resources of traditional behaviors

AFD analysis by Boris Zlotin

- Traditional approach for invention: **let's try improve it**
- Opposite approach by AFD: **Let's try broken it ?**


13) 거꾸로 함(The other way around)

13. Принцип «наоборот»

Waterproof film in the box of cigarette

Feature transfer as process of creative thinking


Version 1



KORTIK.RU

Phenomenon "A + B ≠ B+A"
non-additivity in evolution technics

Resources of traditional behaviors




Association of systems - one of main of mechanisms of evolution of artificial systems. One of surprising properties of this mechanism is it non-additivity and ambiguity. We shall result examples ...

Объединение систем - один из главных механизмов эволюции искусственных систем. Одним из удивительных свойств этого механизма является неаддитивность и неоднозначность. Приведем примеры ...

Version 2


A B



shooting - spring knife

Version 3

Day – night cost of energy




- We can improve problem of consumption of energy if we create 2 types of cost for electrical energy

Resources of time

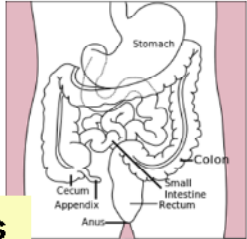
"Internal – outside process"
regarding to function "digestion 소화 of spiders"

- The family Uloboridae has lost its poison glands, and kills its prey with silk instead. Like most arachnids including scorpions,[9] spiders have a narrow gut that can only cope with liquid food and spiders have two sets of filters to keep solids out.[8] They use one of two different systems of **external digestion**. Some pump digestive enzymes from the midgut into the prey and then suck the liquified tissues of the prey into the gut, eventually leaving behind the empty husk of the prey. Others grind the prey to pulp using the chelicerae and the bases of the pedipalps, while flooding it with enzymes; in these species the chelicerae and the bases of the pedipalps form a preoral cavity that holds the food they are processing.[8]



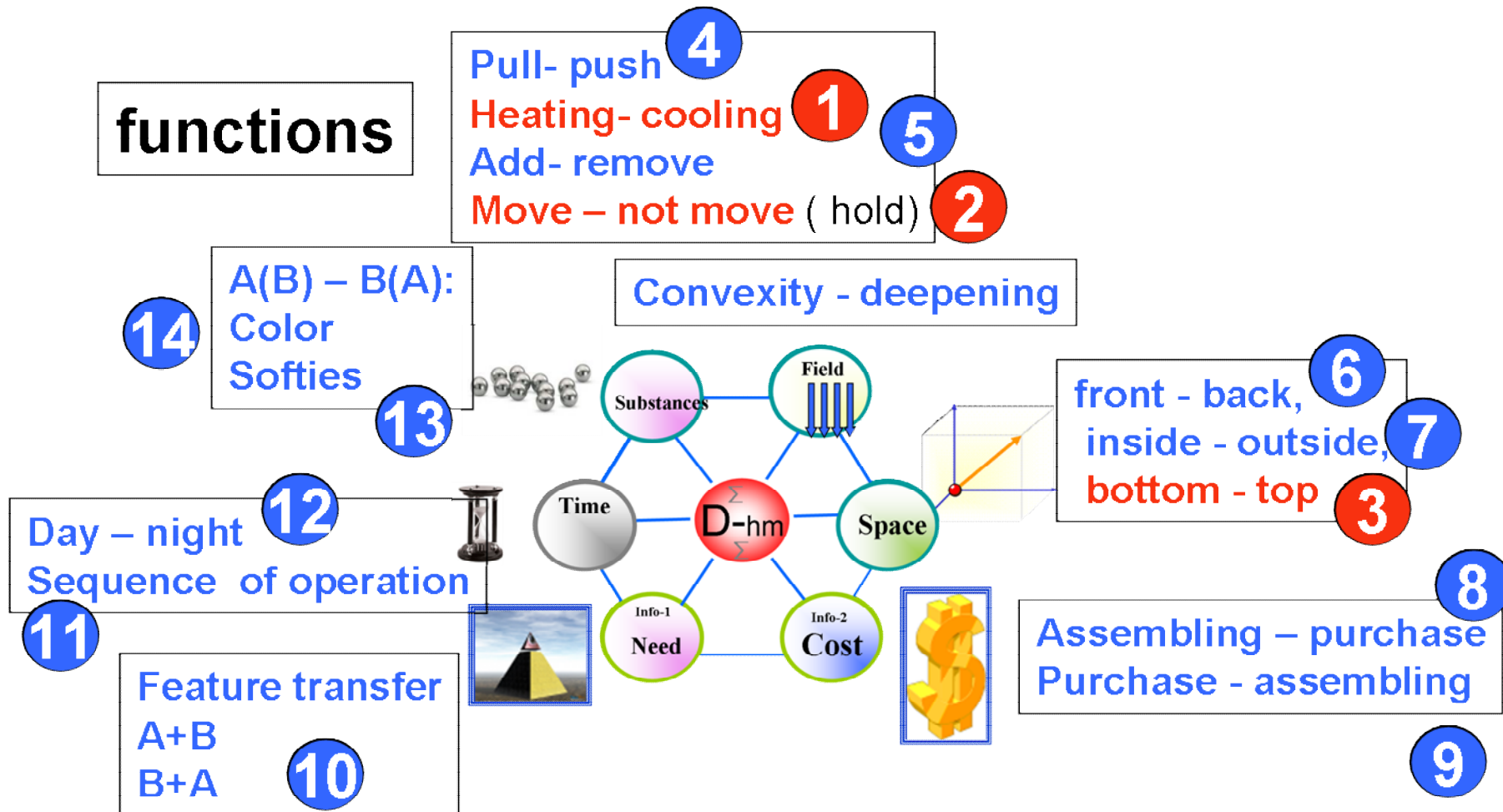
먹이를 먹고 있는 거미
External digestion

Internal digestion



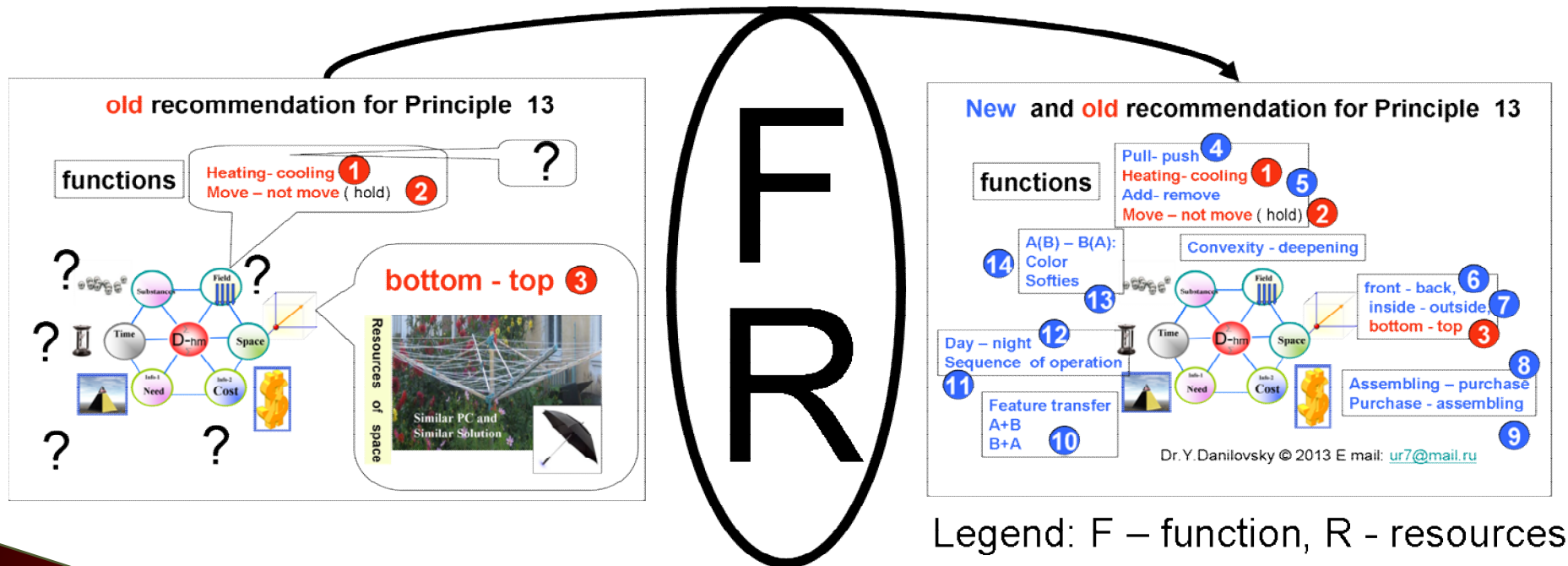
Resources of space, substances and time in Nature

New and old recommendation for Principle 13



conclusion

- ▶ After application of popular TRIZ tools we can consider several additional mechanisms.
- ▶ 4. **function** : “move” pull or push, 5. **function** : “add” or “ remove” substances or fields, 6. **space**: front – back, 7. **space**: inside– outside, 8. **space**: bottom–top, 9. **surface** : convexity – deepening , 10. **substances**: A(B) or B(A) , 11.**time**: day – night, 12. **time**: sequence of operation in manufacturing or business, 13. **strategy of thinking in invention process** : tool AFD by Boris Zlotin, 14. **strategy of thinking in invention process** : feature transfer by Vladimir Gerasimov and Simon Litvin: $A + B \neq A + B$. We can use also several combinations between these 12 mechanisms. Final conclusion: **we can use TRIZ to develop tools of TRIZ.**



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