Limits		Real value	How can the solution look?	Possible solution principle
D	0	Length of the detail < 1 m	The amount of material lost is slight. It should be made easy to find.	Some kind of micro-supplements, that can be detected even in the smallest amounts
	∞	Length of the detail >100km	Remote location – radio location, optical location, heat location.	Location in standard or infra-red rays, radio location
T	0	Discovery has to occur in 0,001 s	Mechanical and chemical procedures are not allowable; electro-magnetic including optical remain	Electro-magnetic radiation
	∞	Discovery must occur in 10 years	Flowing liquid reacts with the pipe's material and changes their appearance	The material of the pipes serves as an indicator
C	0	Discovery costs 0	This is possible when the liquid „communicates" well about itself	Smell, color, quantity
	∞	Let discovery cost $100,000	Add something expensive to the liquid that is easy to find	Supplements of easily accessible materials in micro-doses

fig. 18.6. Table and examples of DTC modeling (G. Altshuller)

We can also quickly note about ***costs*** that a change in this parameter towards an increase only means that we accept the hypothetical possibility of a change regardless of the costs. We have to answer the following question: which changes does this cause regarding the problem? How can it then be solved and why?

DTC modeling is often accompanied by illustrations. We recommend that you make drawings that are as precise and as careful as possible. **Usually a poor drawing means that a task was poorly understood.** The minimum number of drawings is two: "**What was**" (or "**Is**") and "**What became**" (or "**Should be**"). Sometimes it is helpful to make both drawings in the same scale, compare them, and mark the differences with color.

Here are two examples.

Ex. 123. Ring around the earth. This is also an entertaining learning task. It can be easily formulated and has a simple answer. It's important that this training task is solved in 20 seconds! Use a watch with second hand and don't read the requirements until after the assignment.

It's clear that our possibilities to absorb and process and to intellectually evaluate the conditions of a task are not constant and that they depend on several factors. More specifically, when we say in a seminar that a complicated problem should be solved in 20 seconds the percentage of correctly and punctually completed tasks sinks drastically!

Let's assume that a thin movable ring were laid on an "ideally round" earth. You should move this ring so that on one side the distance between it and the

earth's surface is ca. 0.5 m so that you can crawl through. By how many kilometers should you increase the size of the ring?

Ex. 124. Cosmic transportation and industry systems by Unitsky. An excellent example of DTC modeling are the investigations of an unbelievable invention - that is still plausible according to the laws of physics - by the inventor Anotoli Unitsky whom we already know from section 15.3. This time he invented a wheel! This is not just any wheel, but a ball as large as the earth! Unitsky has proposed a ring around the equator that can then become a means for space transportation: in fig. 18.7a "What was = ring", in fig.18.7b "What became = **CTS (Cosmic Transportation System)**". The fantasy element in this project exceeds even Baron Muenchhausen's dreams who pulled himself and his horse out of a swamp using his hair. But the same is true with the CTS – **it transports itself up to the outer space**!

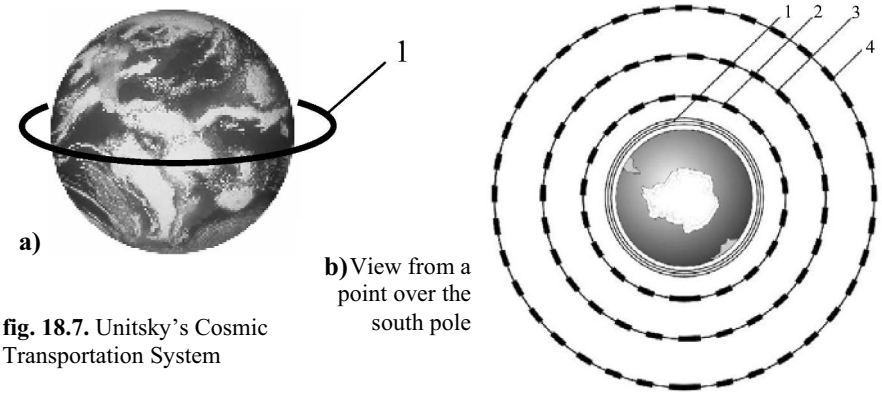

fig. 18.7. Unitsky's Cosmic Transportation System

The ring 1 (fig. 18.7a) represents the rotor of a motor with magnetic mounts. The stator of the motor is mounted in a casing with the rotor and includes the earth, too. The rotor hangs in the casing on a magnetic mount without touching it in any way. The size of the rotor can be 20 – 40 cm. Materials for the construction of plants or facilities in space or raw materials for space industries can be stored inside the rotor. When the rotor is accelerated to speeds above the 1st cosmic speed of 10 km/s, it becomes weightless! Then the magnetic mount is turned off and the rotor boosts into outer space! The casing is discarded at an altitude 10 km (position 2 in fig. 18.7b) and it floats with parachutes back to earth. The rotor then climbs to the altitude desired, position 3 in fig. 18.7b, for example. Here the altitude could be something like 100 km and in position 4 – 1000 km.

The rotor is shaped from sections that are held together with telescopic connectors. It can therefore easily increase its diameter and overall size. At the equator, the earth's diameter of 12756 km corresponds to an overall size of ca. 40,000 km. This is the size of the rotor at take-off. At an altitude of 100 km, its size increases only by about 628 km or 1.6%, but at 1000 km it increases by 6280 km or 15.7%. Compare these figures with the parameters in the previous problem and take into consideration the fact that there the ring lies on the earth on one side and is separated from the earth on the other!

When braking, the rotor starts to get smaller and it can then come back to earth. Here it's possible to recover a large amount of energy!

If only 1% of the construction elements produced today or 50% of the energy produced today were produced in outer space, geocosmic freight transportation would encompass at least 10 million tons per year. To put loads of this kind into orbit by 2020 using space transporters like the *shuttle* with 60 flights per year, we would have to have started earlier with this plan than with the construction of the Cheops pyramid in Ancient Egypt! It is completely unrealistic to transport these kinds of loads into space in one year.

An additional point is that today rocket transportation is already approaching the limits of the economic, technical, and ecological development of its potential. It was computed that the burned rocket fuel from 100 shuttle flights one after another alone would lead to the catastrophic and irreversible destruction of the earth's ozone layer.

The CTS has the capability to transport 1 to 5 million tons of freight in one flight into outer space or from the industrial ring back to earth. Dozens of take-offs and landings can be made per year all of which have essentially no impact on the environment! *The cost of freight transport with the CTS is less than one dollar per kilogram or a thousand times less than rocket transportation!*

The table in fig. 18.8 shows a short overview of the procedures for inventing that Unitsky put into praxis with the CTS.

At the start of the III. millennium, the use of this kind of cosmic transportation system is ***the most practical of all true fantasy ideas*** to create a geocosmic industrial civilization.

In conclusion, here's another optimistic word by G. Altshuller: "The use of fantasy techniques has absolutely nothing to do with memorizing patterned texts. Depending on the personality of a concrete person, one and the same exercise can be done in different ways. Here it's like in music in that *technical procedures help to uncover individual qualities* and, interestingly enough, sometimes an exercise is aesthetically just as pleasurable as well played music."

18.3 Method of "Modeling with Small Figures"

The first example of the use of TRIZ on itself to promote its own further development was probably the development of the *Method of Modeling with Small Figures (MSF).* G. Altshuller investigated the *contradictions* of the procedure empathy (put yourself in the place of the object to be changed) from Gordon's synectics. Its strengths are the use of fantasy and sense organs to stimulate the powers of imagination and its weaknesses include the essential limits of the method in certain frequent transformations such as segmentation, cutting, dissolving, turning, fragmenting or condensing, pressing parts together, heating, etc. Empathy should be present, but it should also not be relevant! An ideal solution is often the principle of copying. This is how we can model actions and influences but with a model figure designed for the situation, not with ourselves as inventors. Or