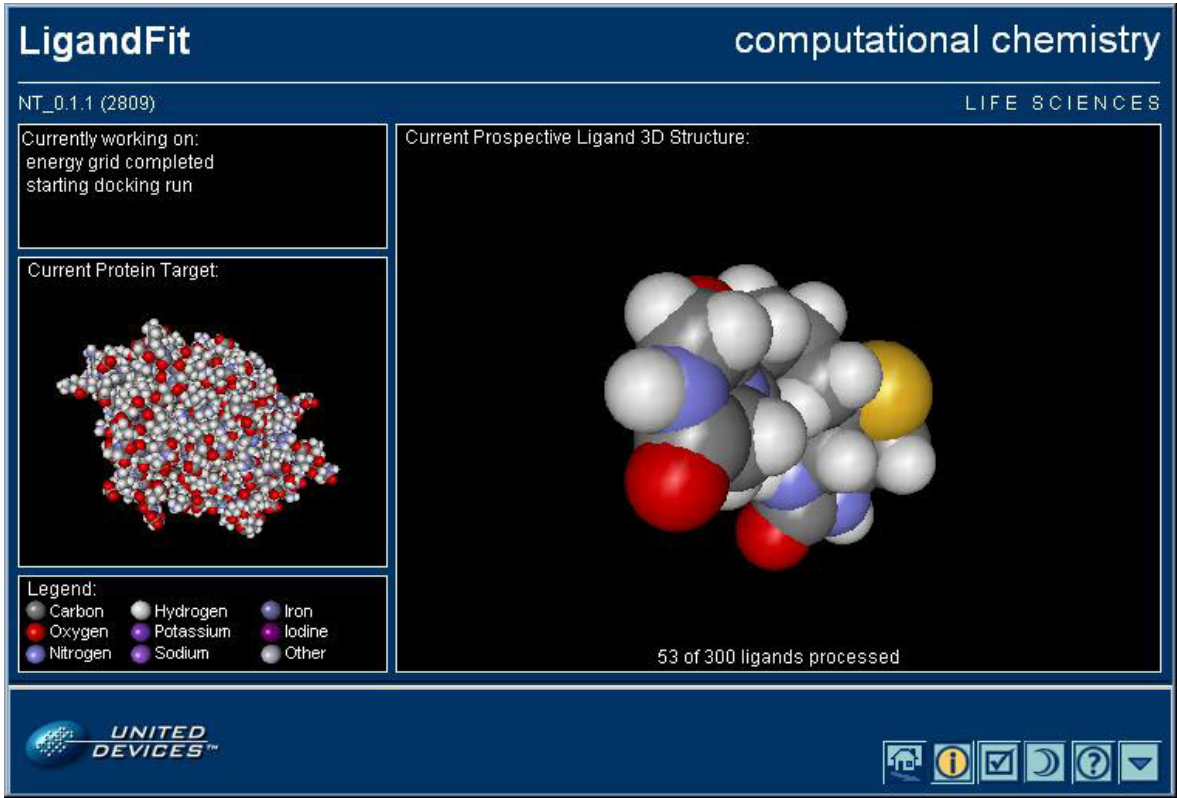
Difficult Problems and New Horizons

Development of the notion of Difficulty in TRIZ

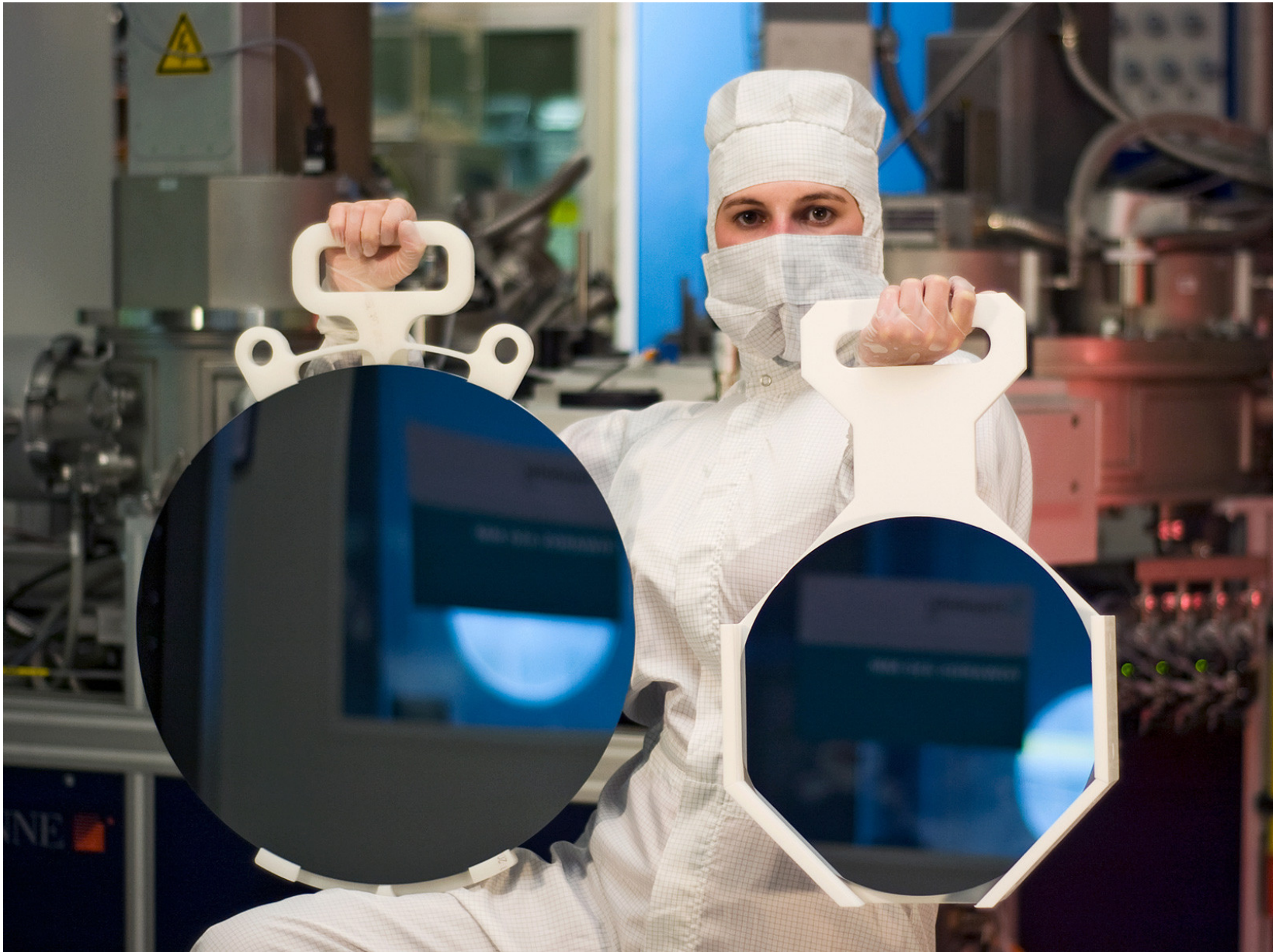
Creative work is often expressed as a leap

5 technological modes. 1980 - 2010
International specialization, “smart” machines. Quick training on strange errors

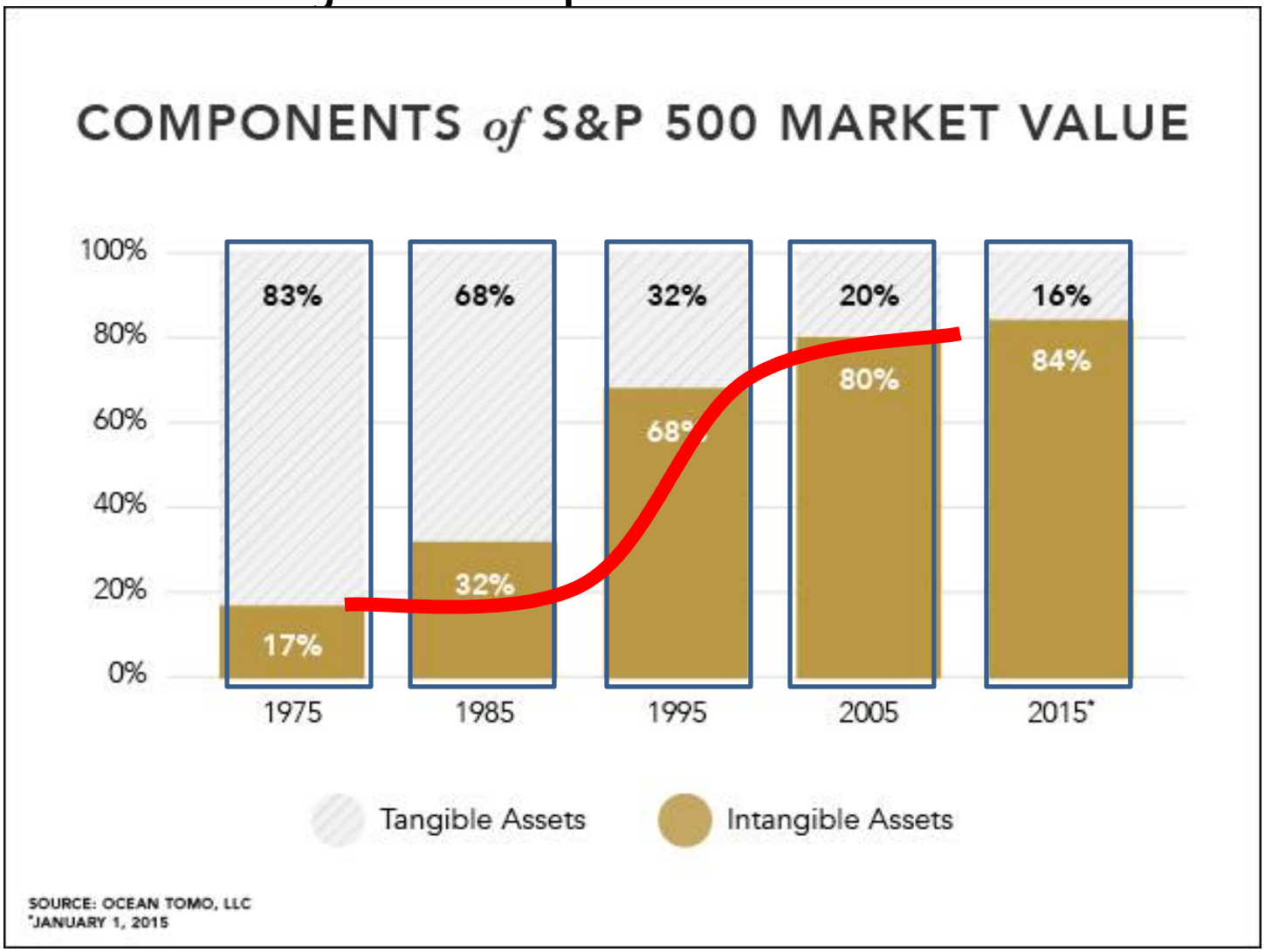
- Computers
- Telecommunications
- Electronics
- Internet
- Light Chemical
- Gene modification technology products



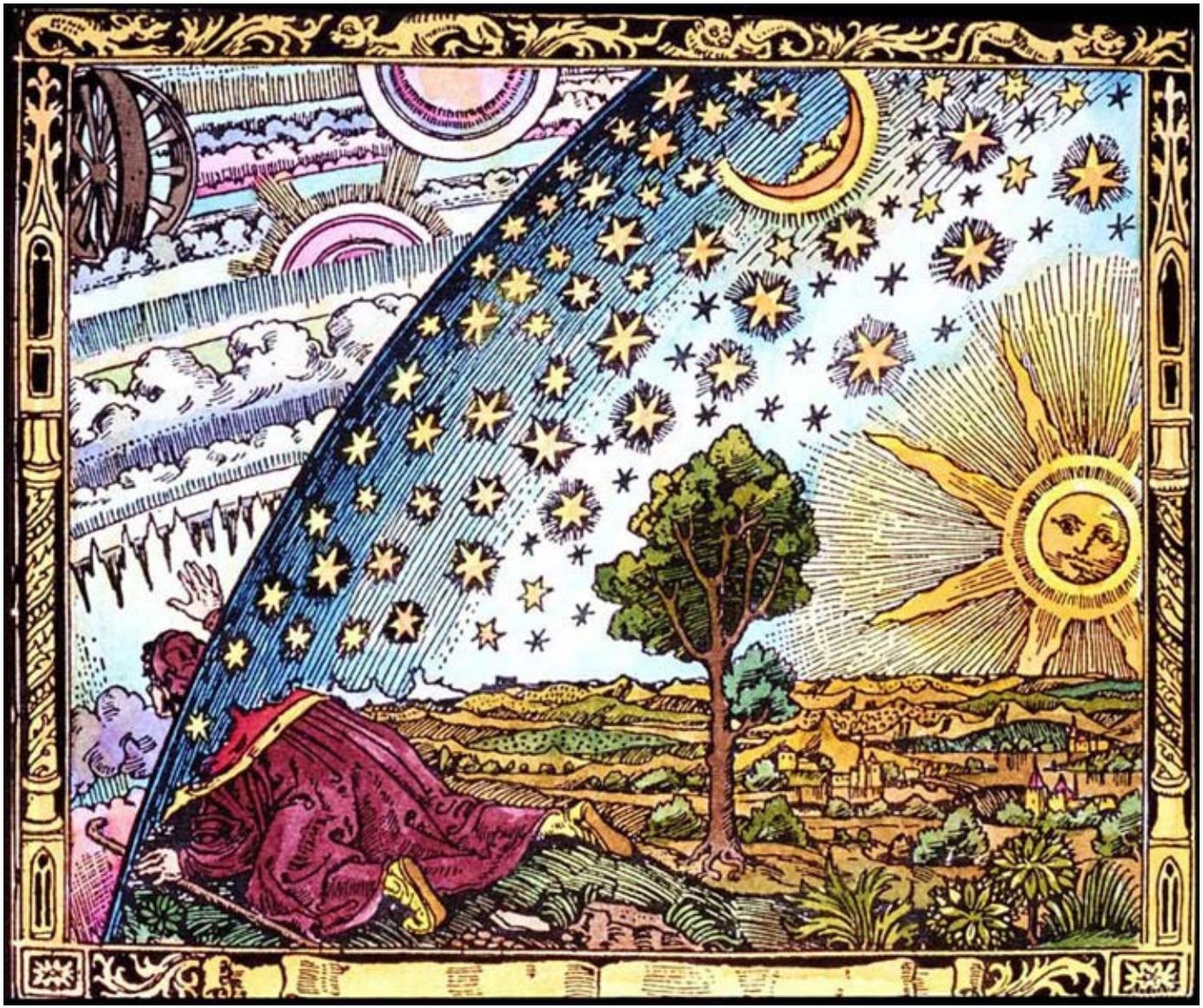
International specialization, “smart” machines. Quick training on strange errors



Share of soft asset in corporate value of 500 major companies in the world



- The world entered a new development phase.



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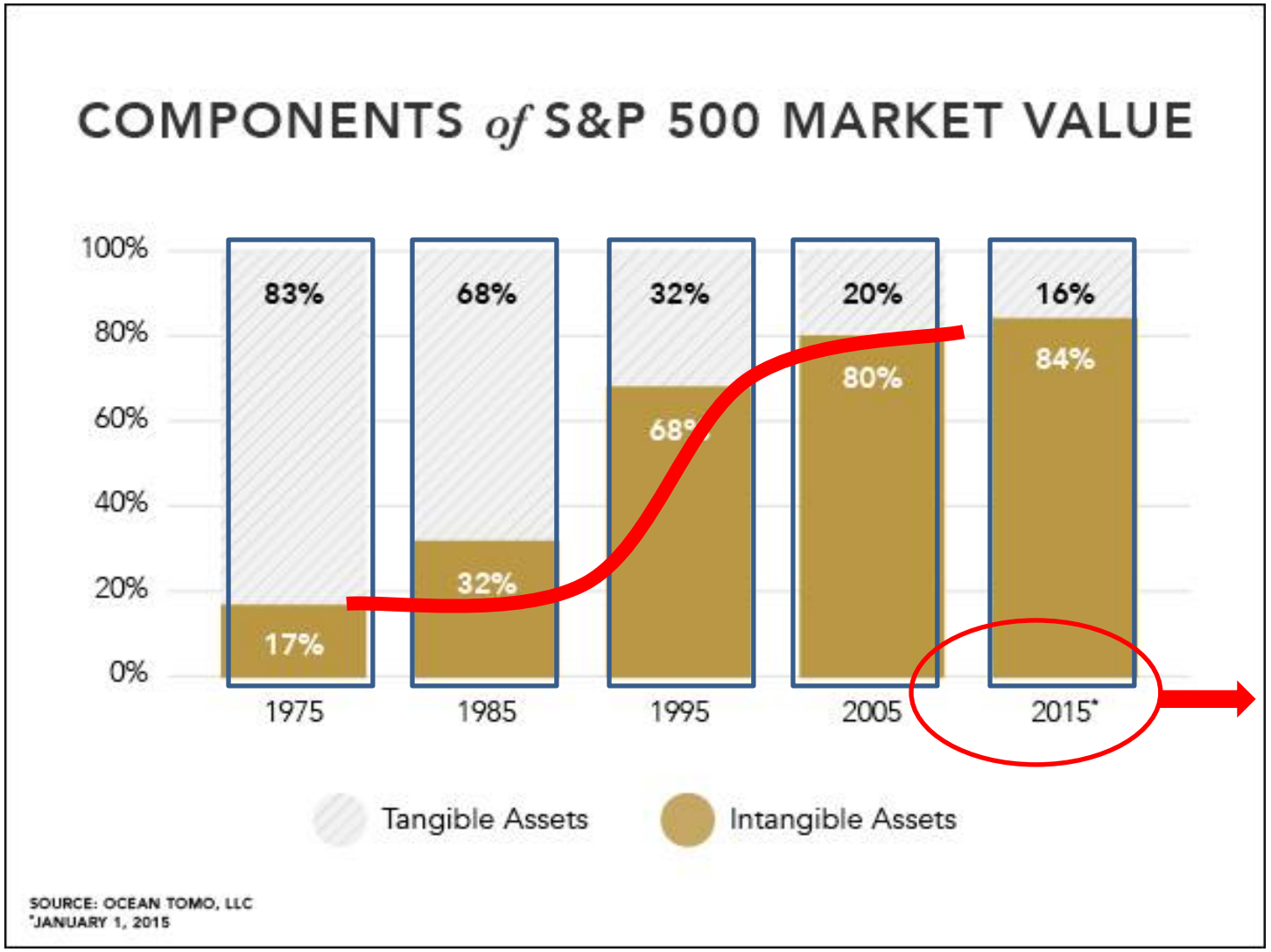
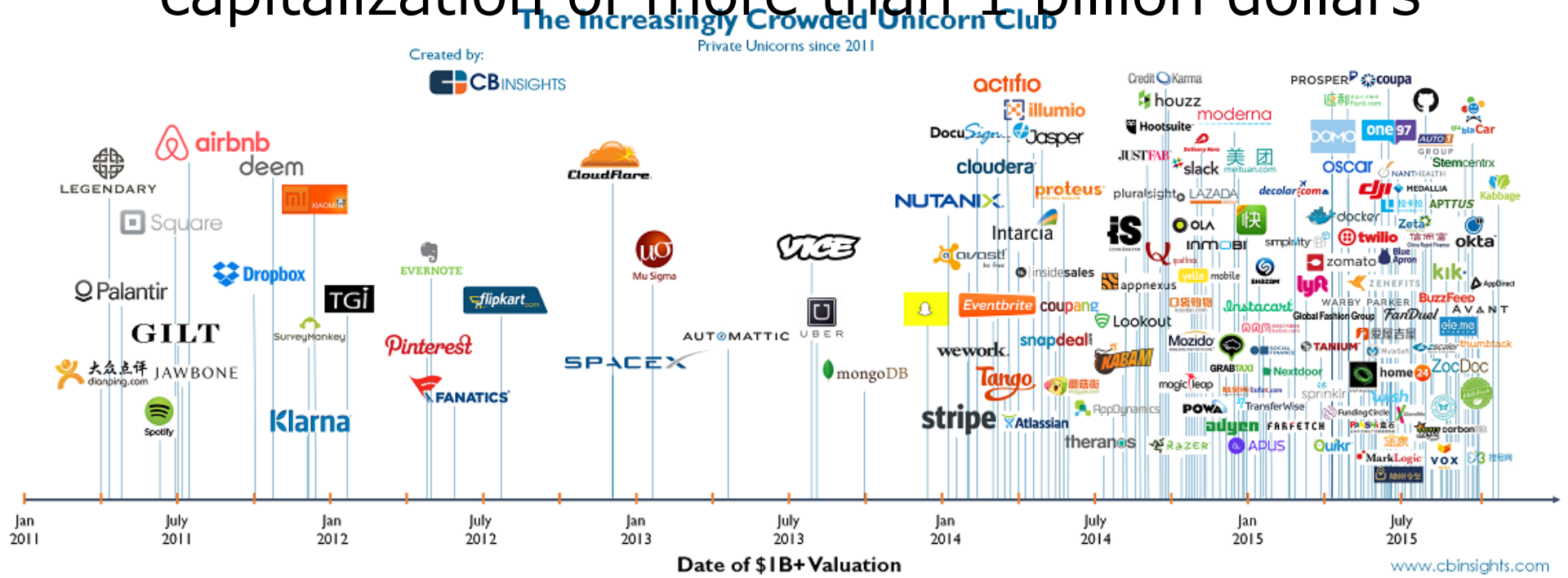


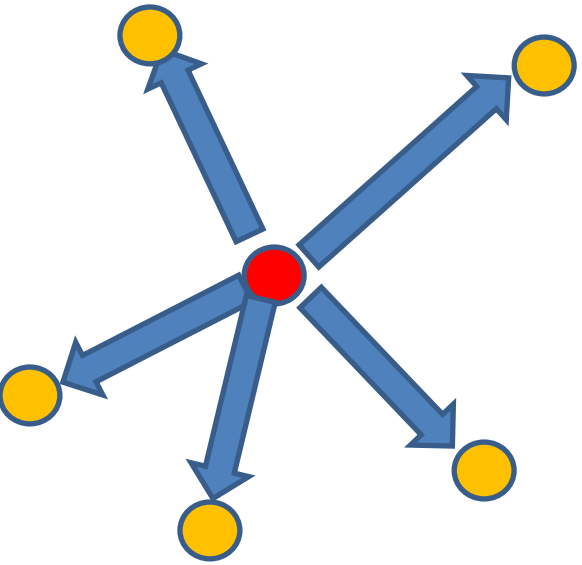
New “Cambrian explosion”
New private technological companies, with capitalization of more than 1 billion dollars



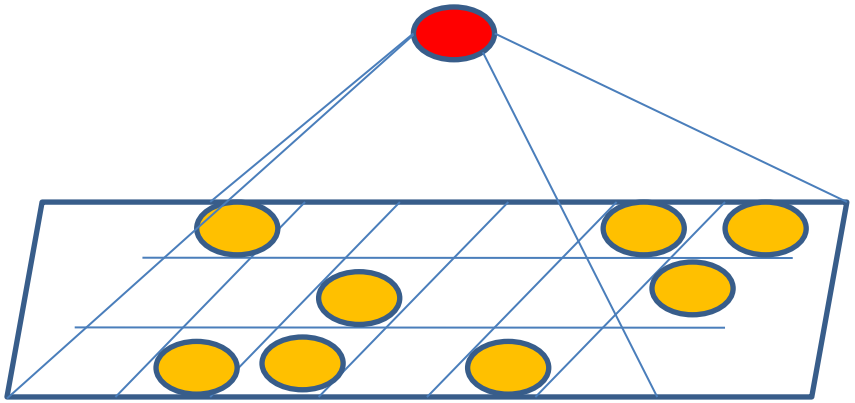
trends-that-will-echo-into-2016 /? utm _ content = buffer06c3a utm _ medium = social utm _ source = twitter.com utm _ campaign = buffer

It is possible to increase efficiency of creative work by

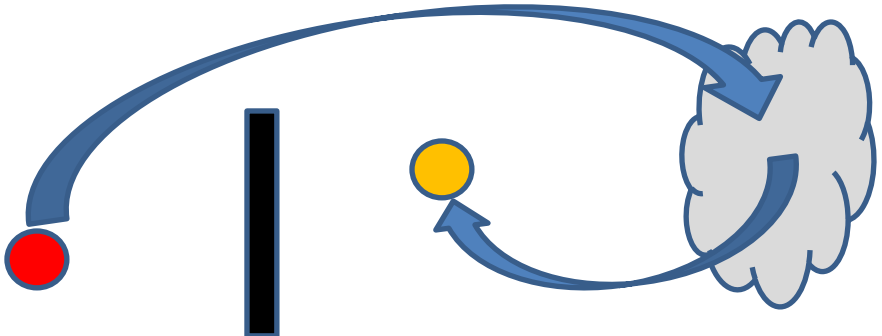
finding
many ideas



finding
all ideas



finding only
the best ideas

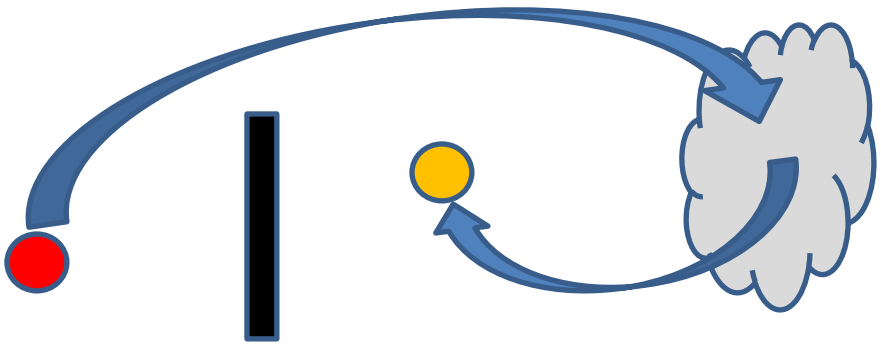


1956

- Technology develops along with a law, which can be taken into account and used in a real invention practice
- Technology develops through elimination of arising contradictions.

www.altshuller.ru/photo/photo04.asp

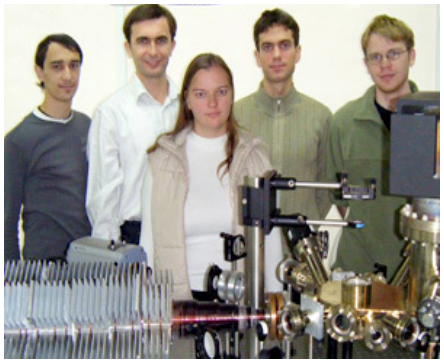
GENRICH ALTSHULLER
1926 - 1998



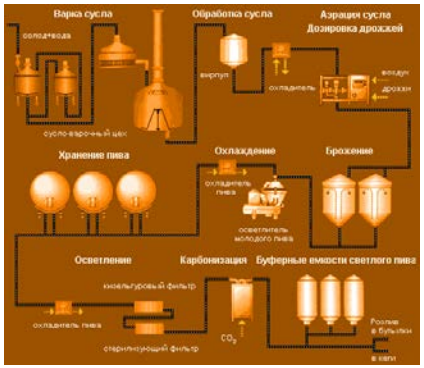
TRIZ - a complex of tools for the development of technical systems within the limits of the given conditions

- TRIZ was created as a system for evolving a product surely in the appropriate direction.
- Its main tool – the revealed laws of technical evolution

Technical system – artificially created controllable system

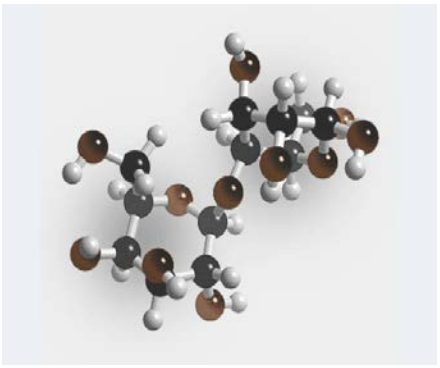


Team, structure for cooperation



Technical process, a series of events

Device, relative positioning of parts



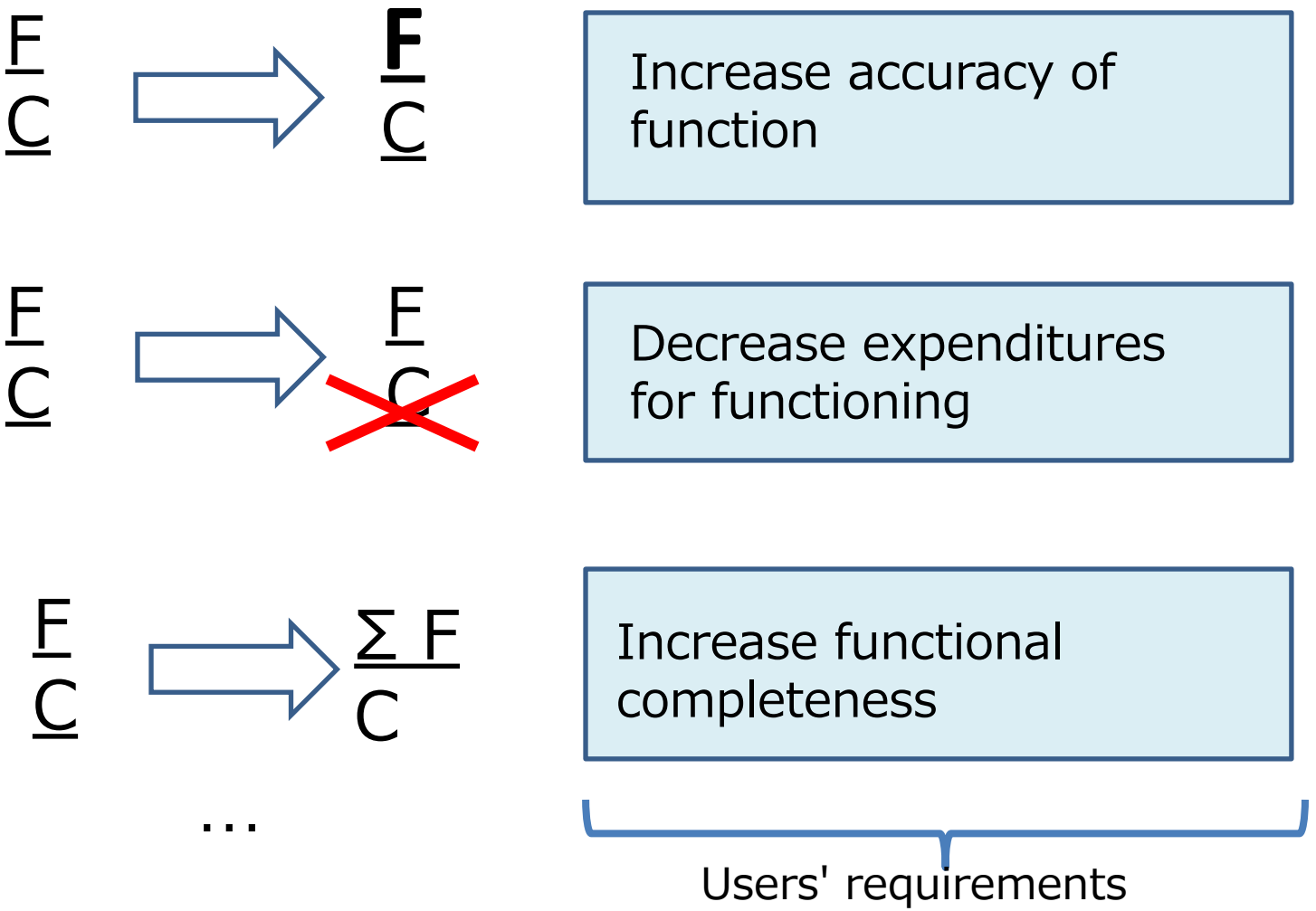
Substance, relations inside

A system can be characterized by the ratio of its utility (through useful functions) and the expense required for its creation and work

$$\frac{F}{C}$$

Evolution - process of change which continues securing useful functions under more and more difficult conditions

System evolution can be lead in different directions



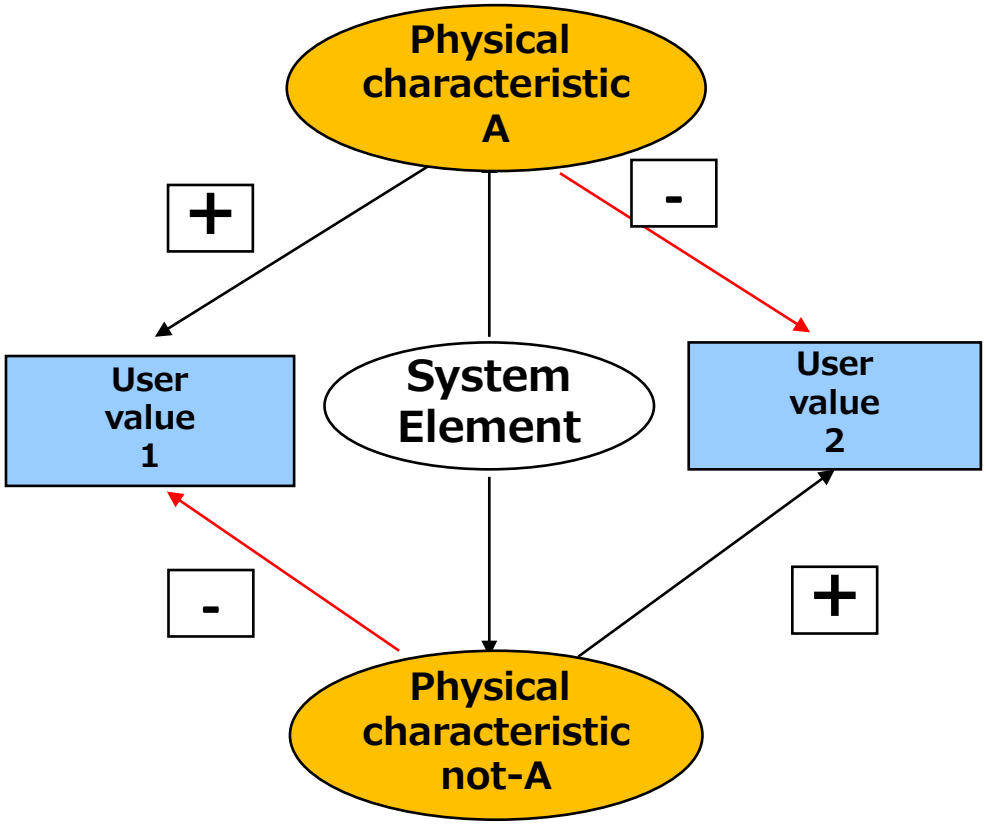
TRIZ: 70s - learn to solve the problem well

- The tools for revealing and solving contradictions
- Heuristic algorithms
- Standard solutions set

To solve the problem

Model in TRIZ

Contradiction



Ideality

Absence of expenditures for creation and functioning → Effective conclusion

1975
The theory of inventive problem solving (ТРИЗ) - A tool system for purposeful search of a new solution in impasses.

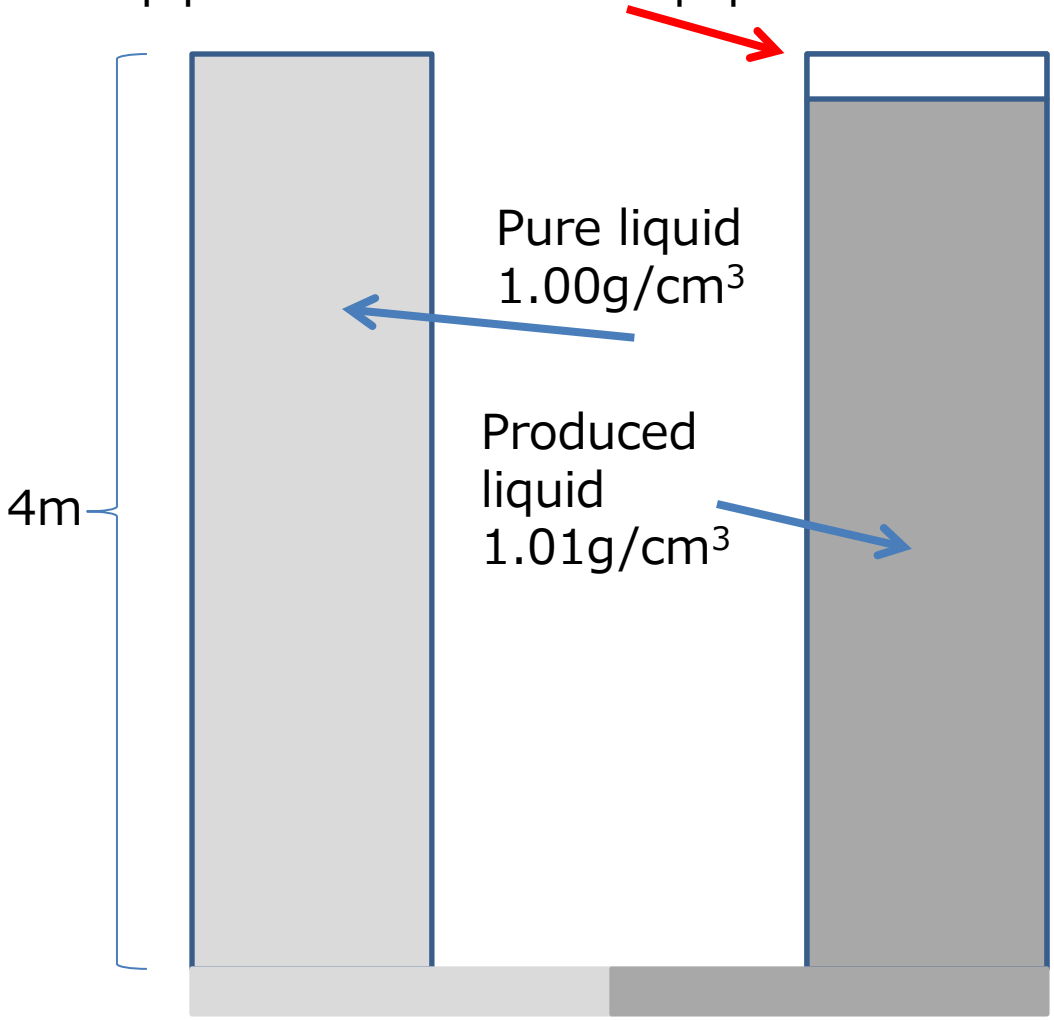
Problem types

- Finding exit in impasses, Removing contradictions

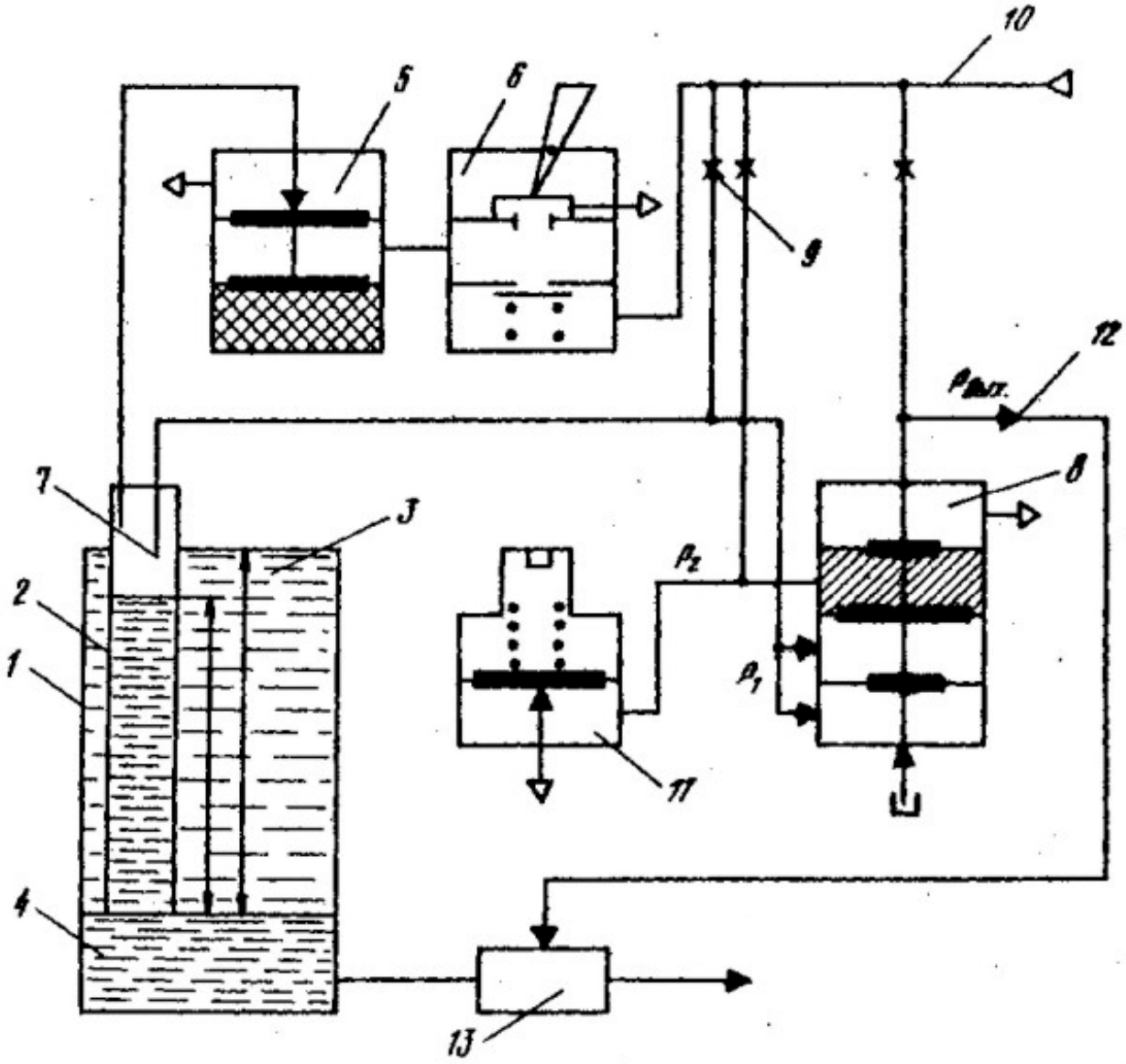
Problem solving example: Settler of household and industrial wastes

Total problem solving outline

Difference in the height of the liquid in the pipe connected with equipment 4cm



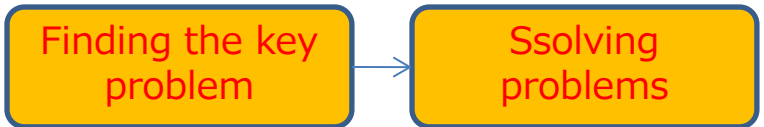
Precipitation liquid height measuring instrument



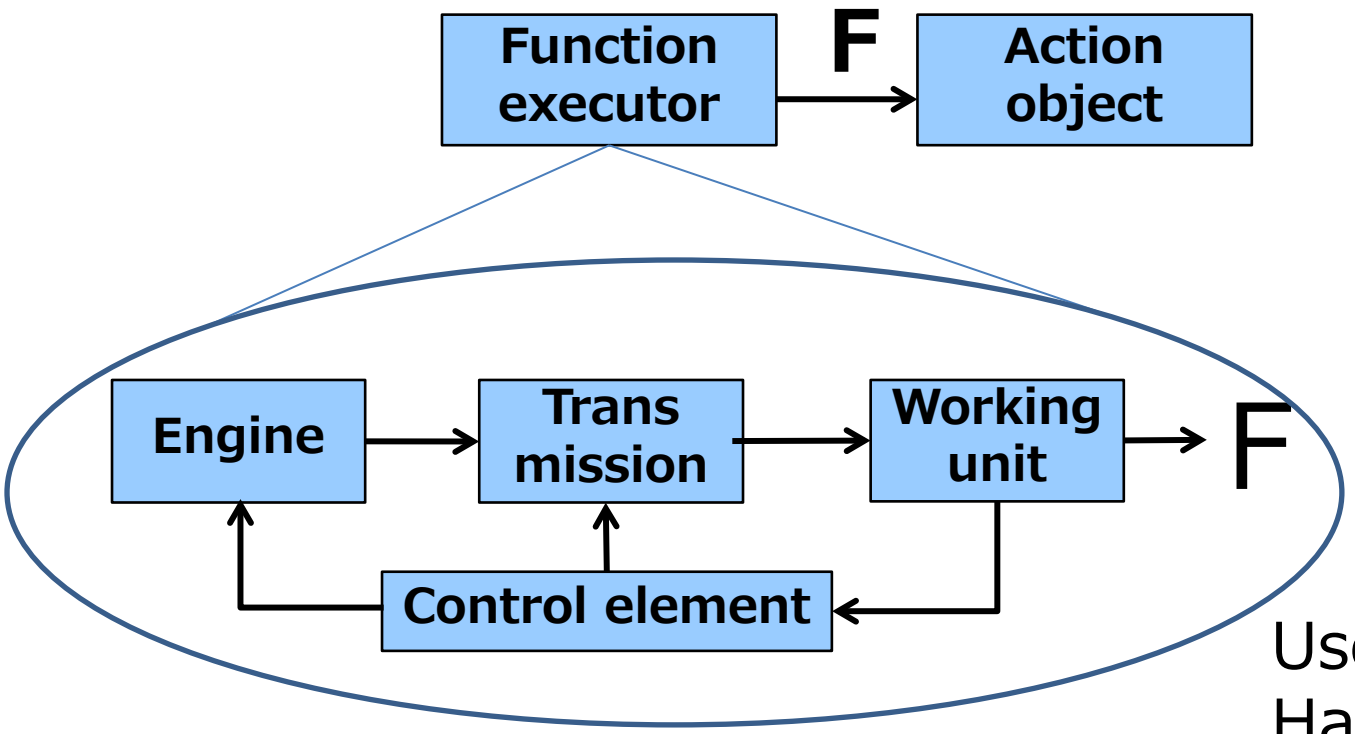
TRIZ: 80s - Finding the key problem

- Functional model
- Cause-effect chain
- Trimming
- Feature transfer
- Flow analysis

solving the problem well
The tools for removing contradictions: Inventive principles, Standard solutions set, heuristic algorithm



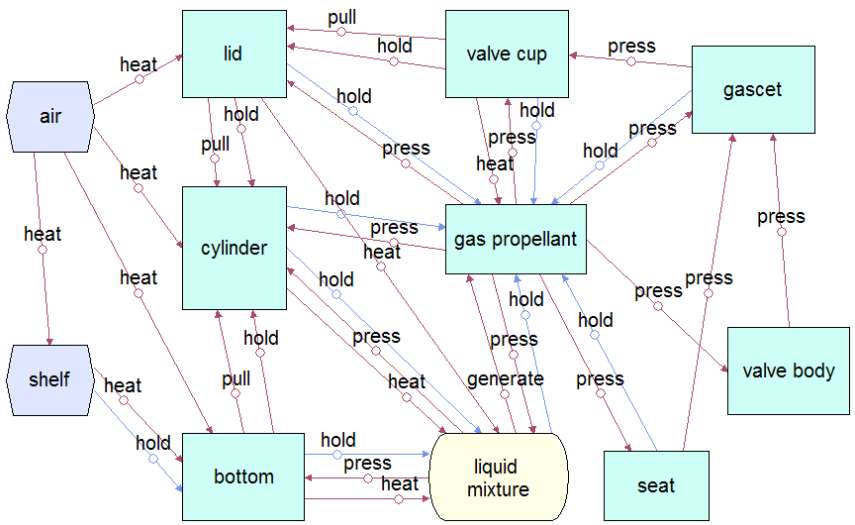
Functional analysis in the TRIZ. Example of change of the tool

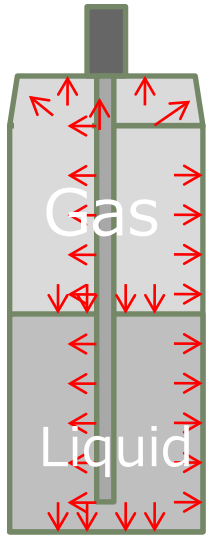


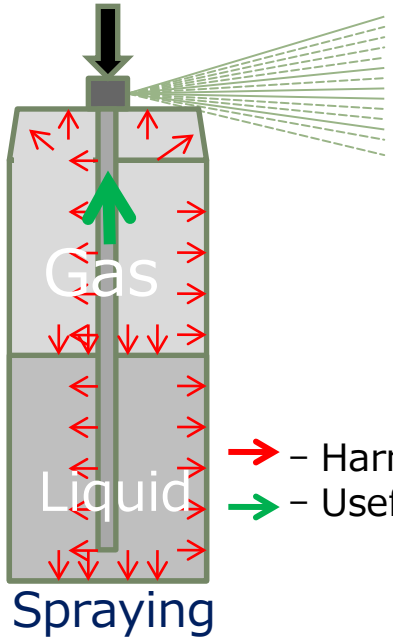
Useful function
Harmful function

Pressurized gas has no useful functions during storage
During spraying, only pressure in the dip tube is useful
All other pressure (on the walls of the can; gas on liquid) is not useful

FUNCTION ANALYSIS: HAIRSPRAY IN THE CAN





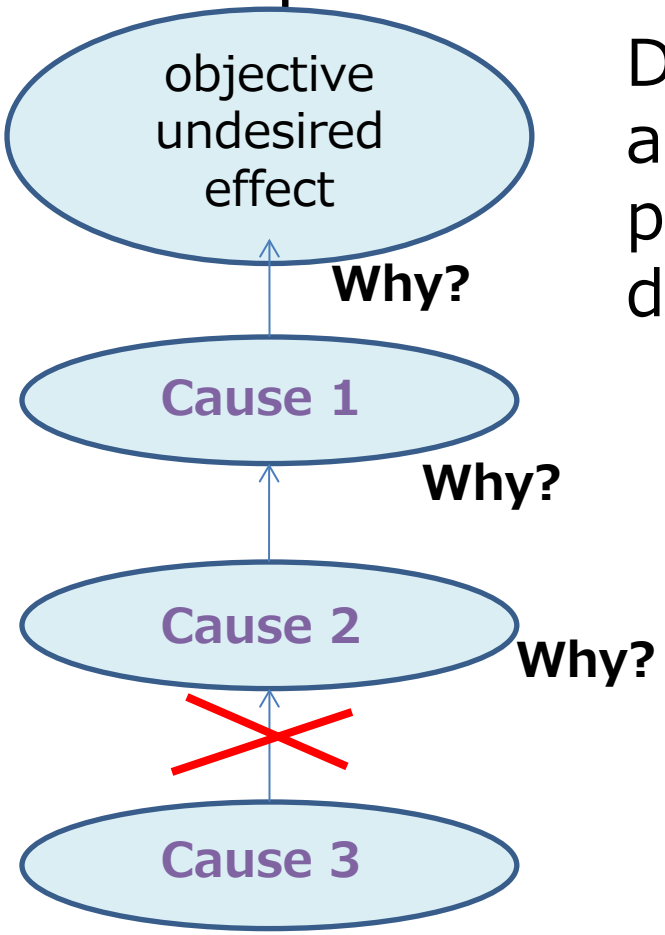


Cause-effect analysis in TRIZ

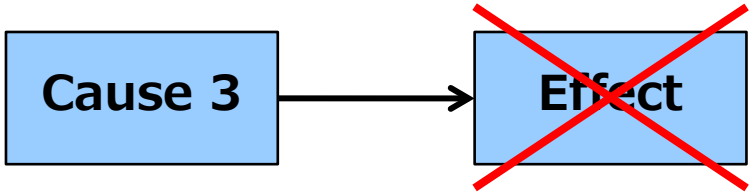
“5 Whys” is a widely known method.
Purpose of the method - to reveal the key reason of the deficiency that is frequently hidden, and not visible.
It is said that Mr. Sakichi Toyoda advocated this method.
The designer of Toyota Prduction System – Taiiti Ono believed that this tool does decision more scientifically substantiated.

In TRIZ method, “5 Whys” has been improved:
- Verification rules were introduced
- Denying operators were introduced

Introduction of denying operator - statement of the problem through breakage of the chain



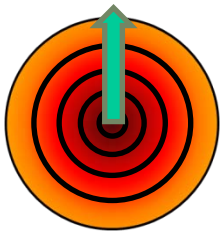
Denying operator logic design, where acceptance of the cause for the phenomenon is combined with denying the effect



Task: How to achieve that the cause remains, but there is no negative effect generated from it.

Cause-effect analysis

Deficiency chains in a Technical System



Movement “to super-system”

Super-system

Deficiency

Deficiency

Deficiency

Deficiency

The key deficiencies

The zone of work of the Cause-effect analysis

Purpose-oriented (known, obvious, interfering) undesired effect, elimination of which is the purpose of problem solving

Deficiencies revealed as a result of functional and flow analysis

Deficiency

Deficiency

Deficiency

Deficiency

Deficiency

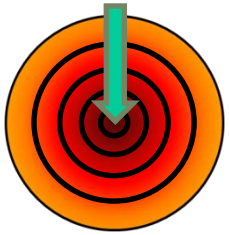
Deficiency

Deficiency

Deficiency

The zone of work of the Cause-effect analysis

The key deficiencies



Movement “to subsystems”

Subsystem

Cause-effect chains of deficiencies in a Technical System

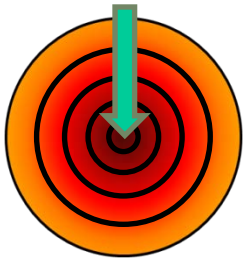
Example of the initial problem: It is required to locate a new equipment on the spot, but there is no place for it.

problem: Where to locate the new equipment?

There is no place for the new equipment

Reserve apparatuses are necessary

Apparatuses are frequently removed to repair



Working apparatus is quickly littered by product

Product sticks to the apparatus wall

Product melts on the apparatus wall

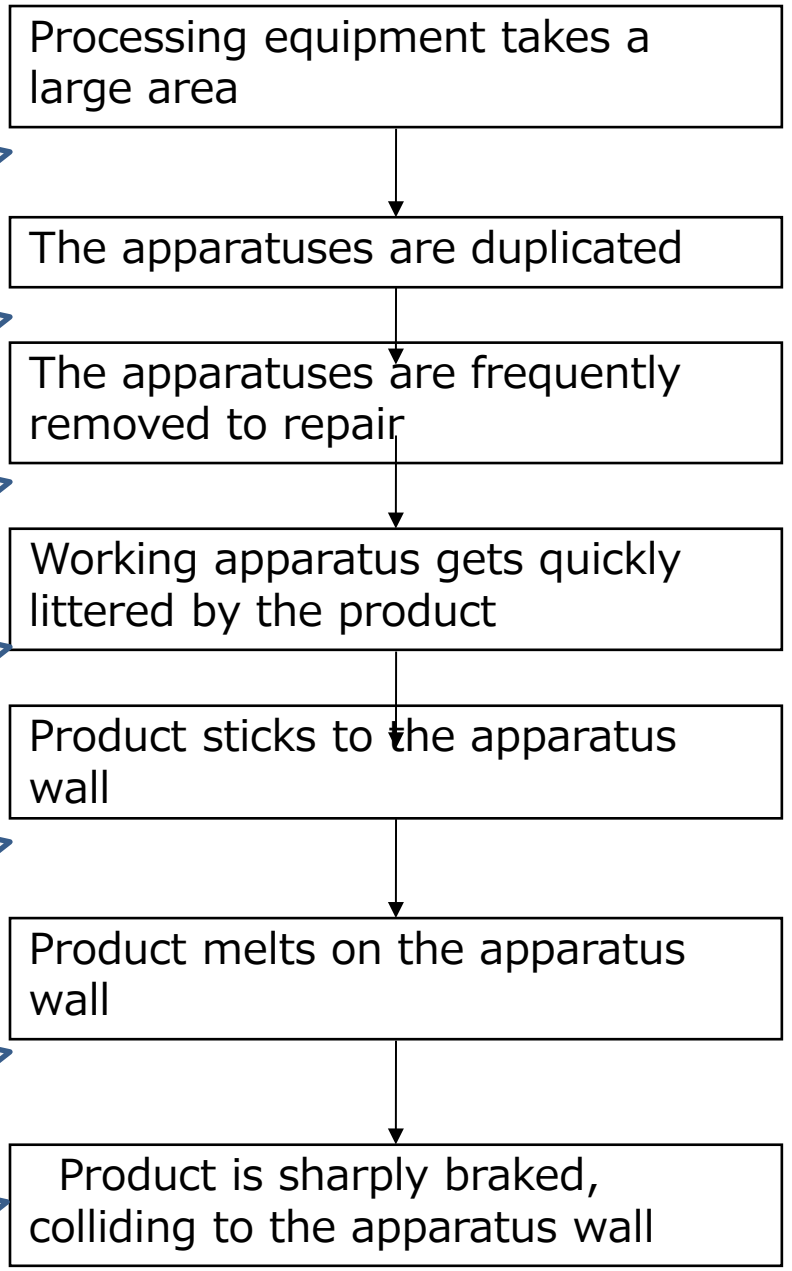
Product is sharply braked, colliding to the apparatus wall

The key and intermediate problems

Intermediate problems. How to make:

- Apparatuses are duplicated, but it is not necessary to remove to repair
- Apparatus stops, but it need not to be duplicated (instant clearing)
- Apparatus gets littered, but it is not necessary to stop work
- Product sticks to the wall, but the apparatus does not get littered
- Product melts, but it does not adhere to the wall of the apparatus
- Product gets instantaneously braked, but product does not melt

The key problem: how to brake the product smoothly, gradually



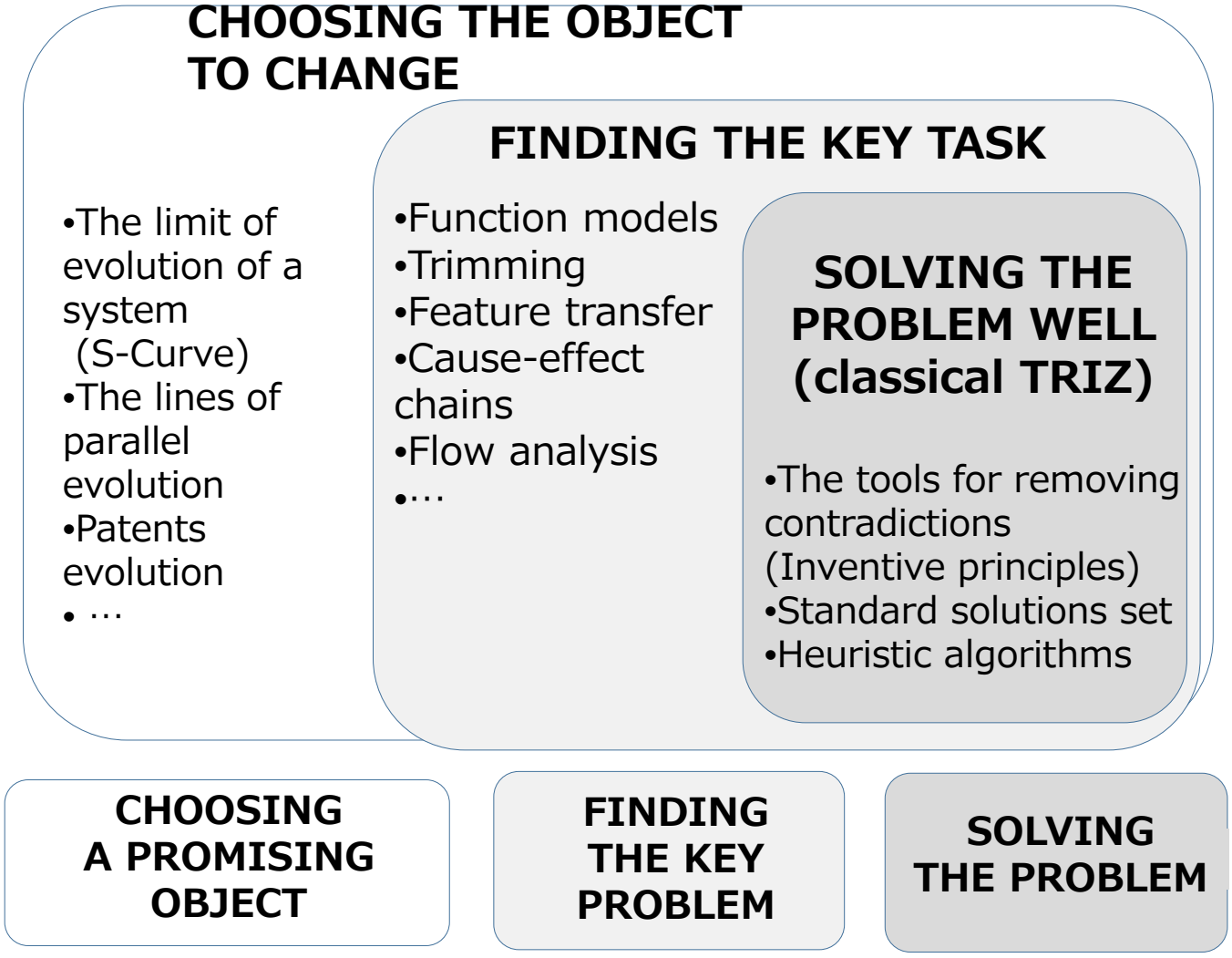
1985

Theory of Inventive Problem Solving (ТРИЗ) - it is a set of tools for analyzing the problem situation and purposefully searching new solutions.

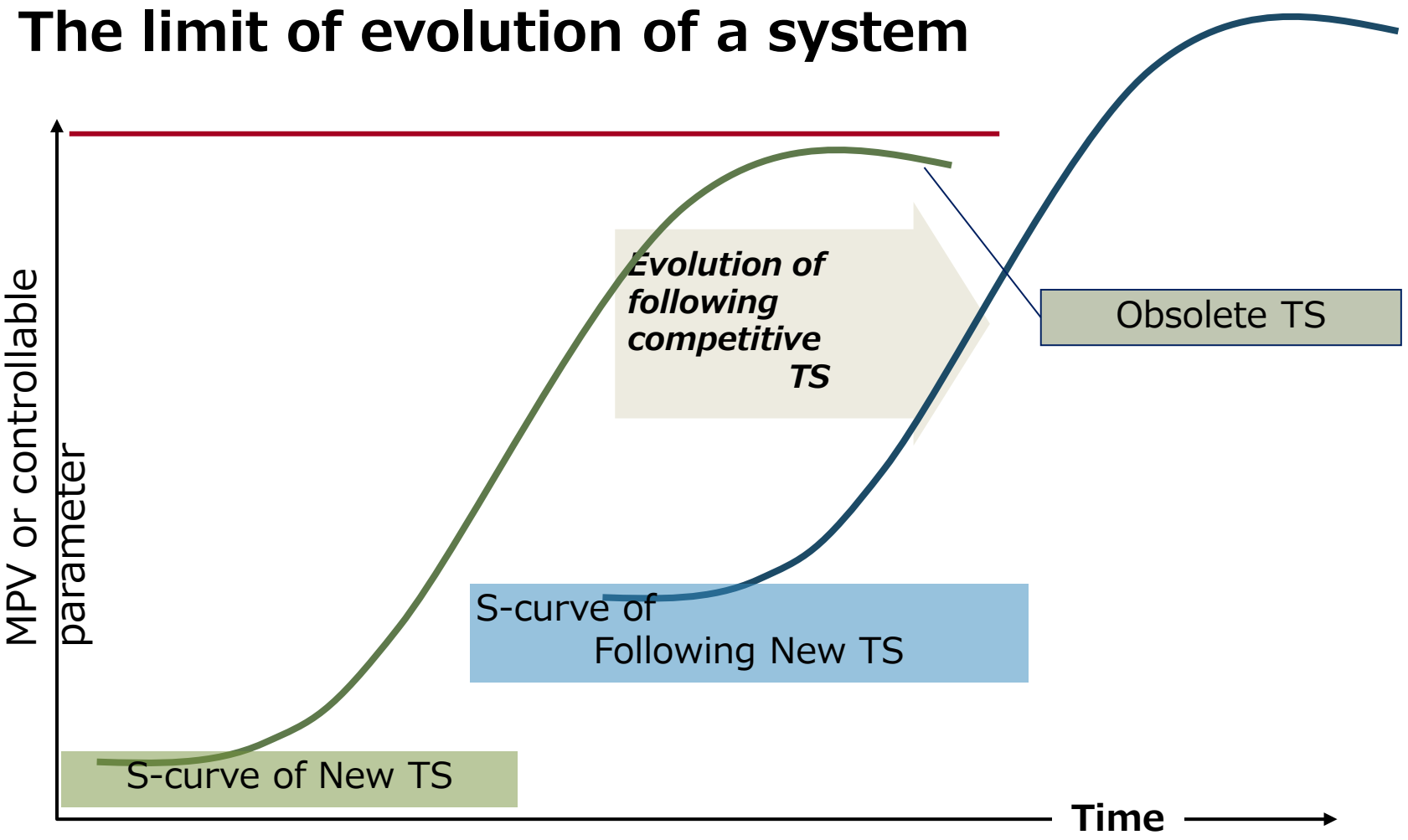
The type of problems

- To reveal the weak places and to remove them
- To execute development forecast
- To evaluate the influence of an event to the environmental elements

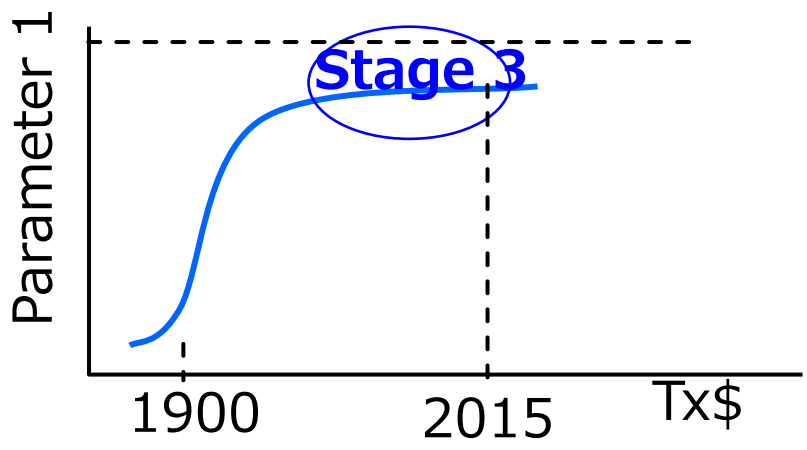
TRIZ in the 90s: CHOOSING THE CORRECT OBJECT TO CHANGE

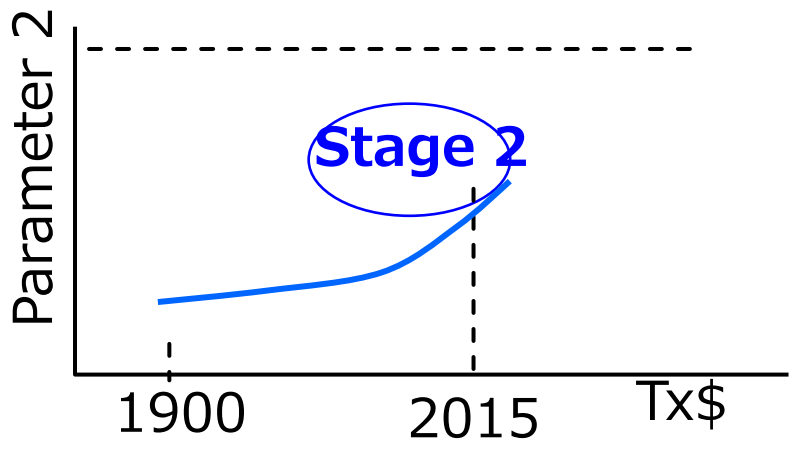


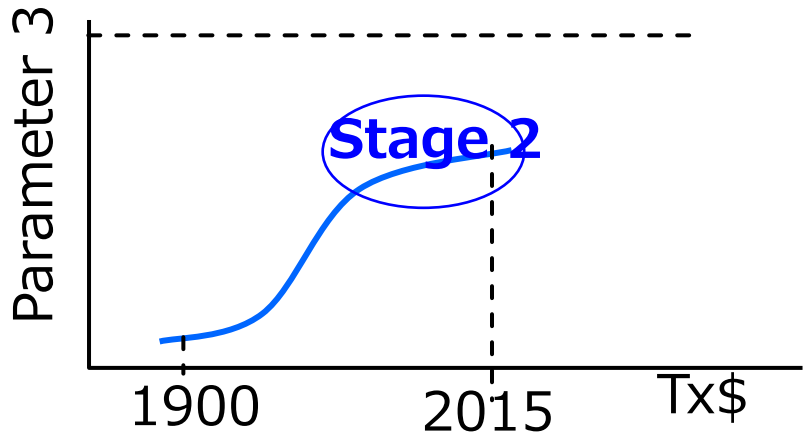
Systems evolution. The limit of evolution of a system

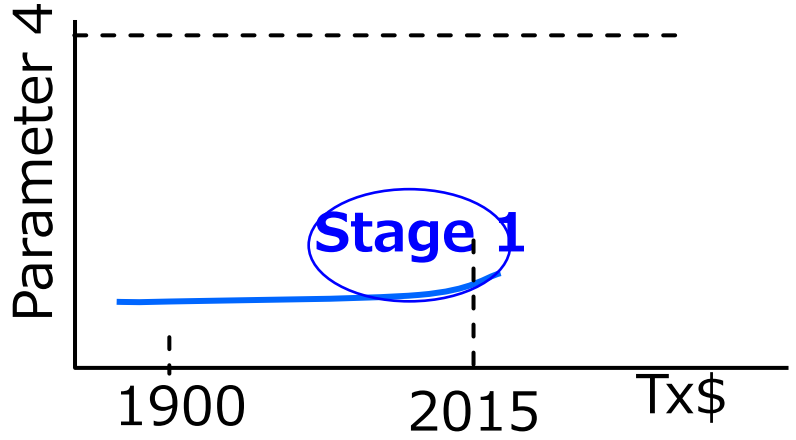


Characteristics of a system can be in different development stages









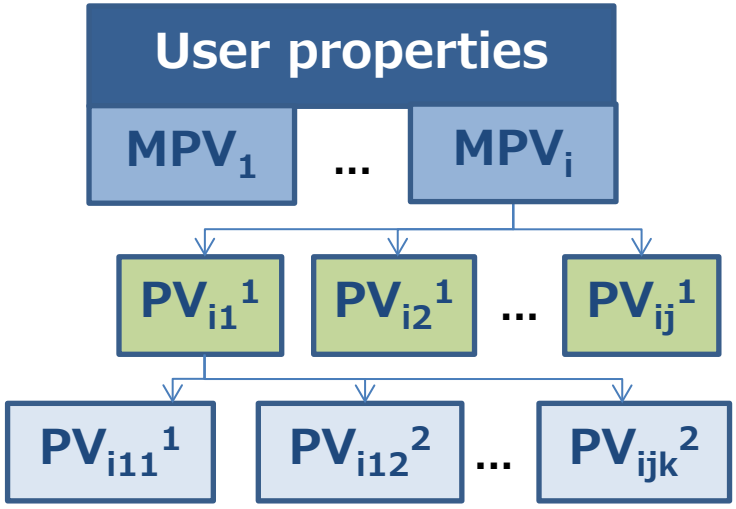
Systems evolve until the depletion of the potential of action concept incorporated in them.

It does not make sense to improve a system, the potential of which has exhausted.

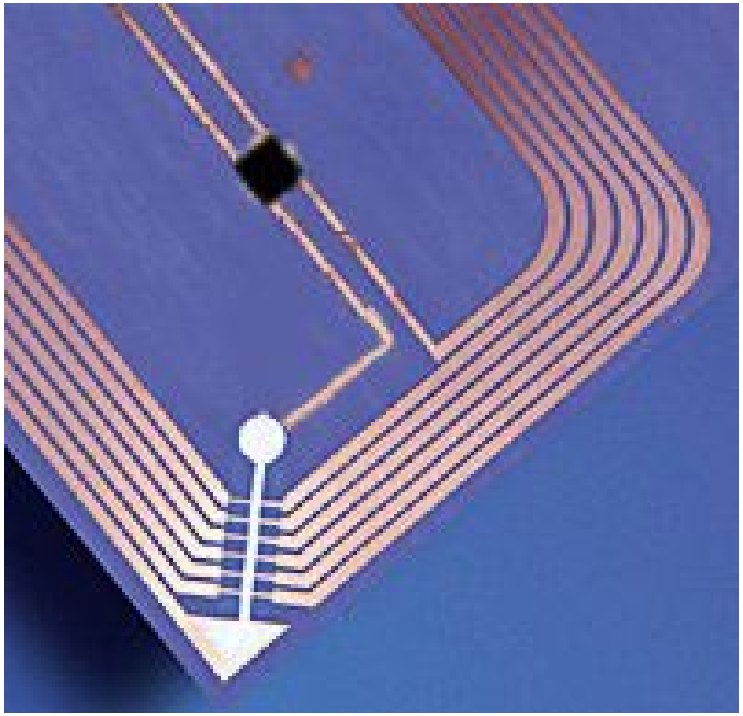
Speed limit: 9M

Speed limit: 2.5 - 3M

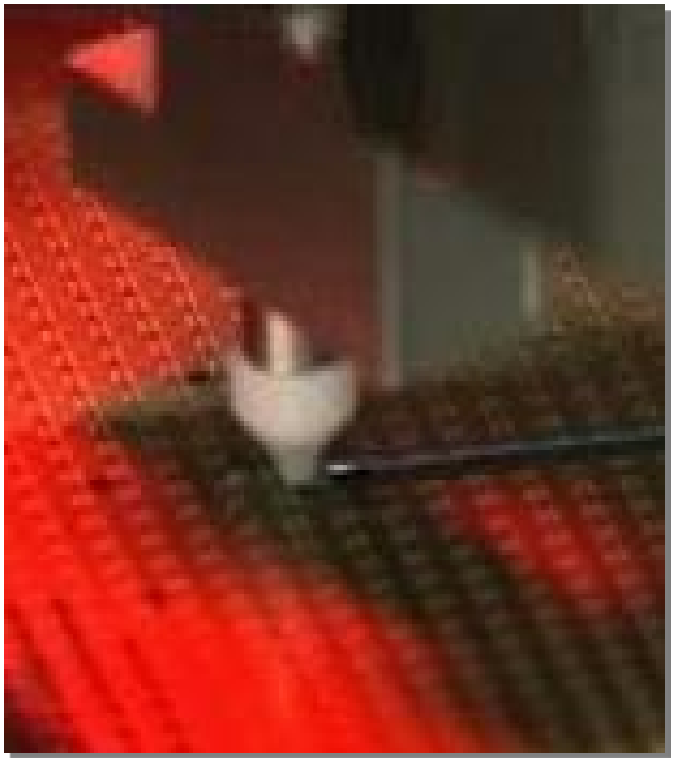
Speed limit: 1M



Example: the RFID manufacturer’s problem:
It is necessary to increase the production quantity of a product 50 times without increasing the floor area.



Flip-Chip mounting technology which the user is using

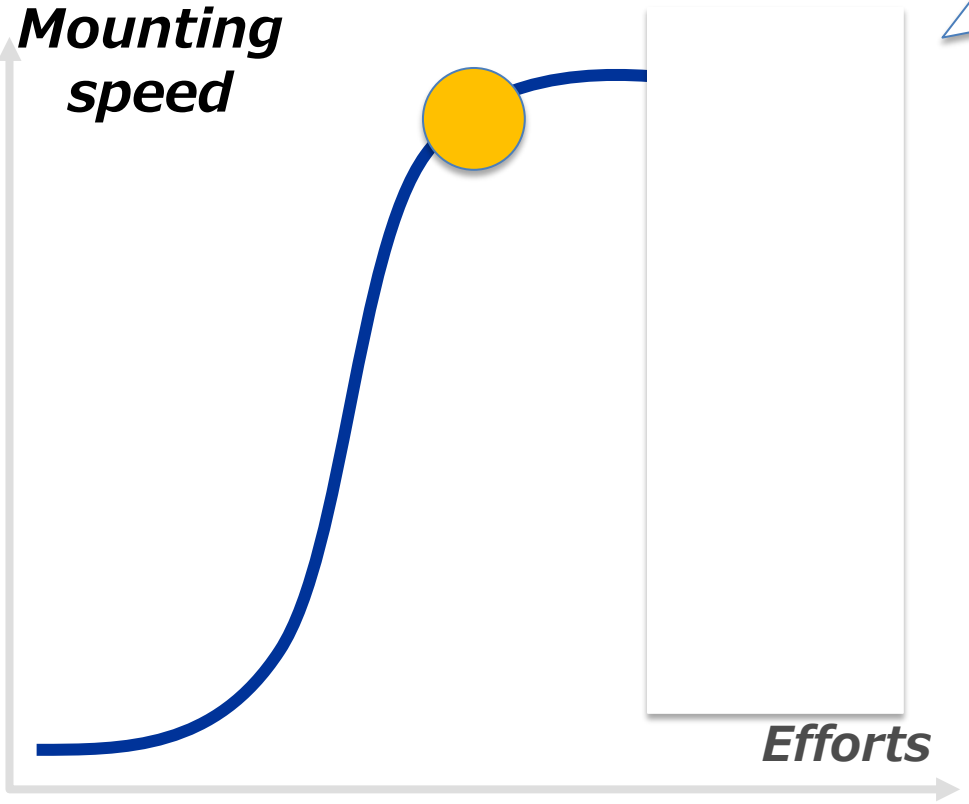


Grab-1 is attached to the chip on the plate (by vacuum suction cup) and then passes the chip to grab-2

Grab-2 goes to the tape with aerials and installs the chip to the contact part of the aerial

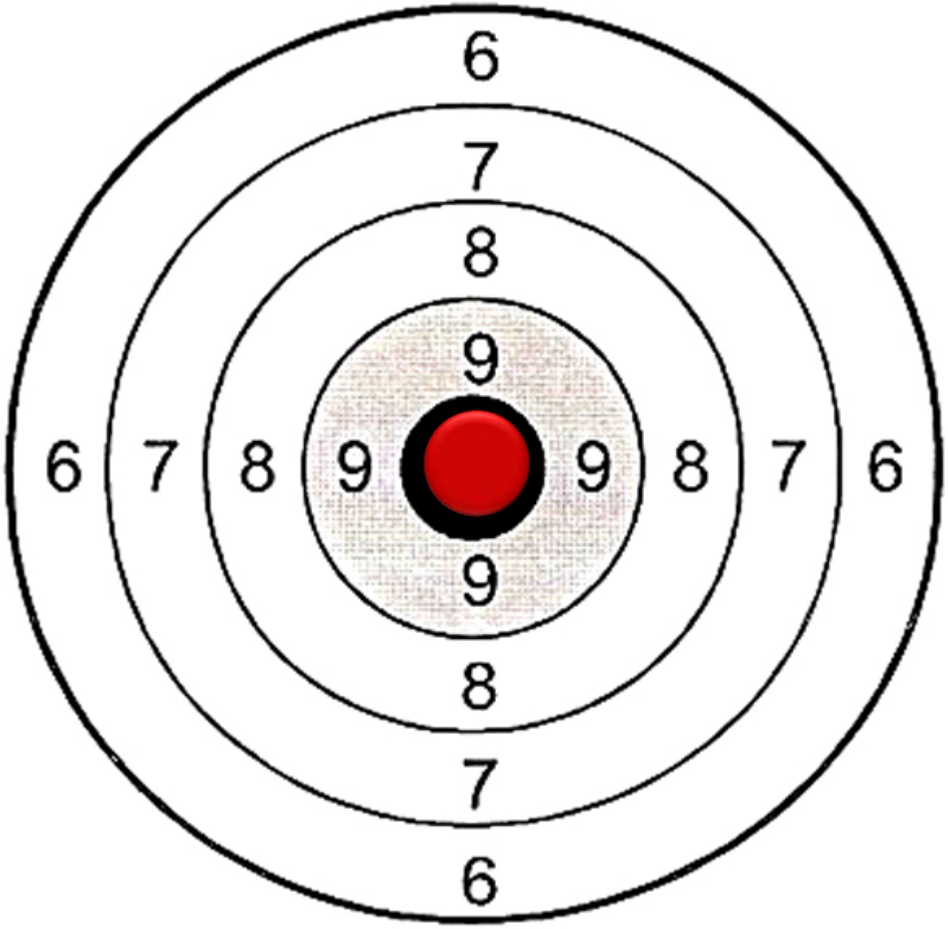
Acceleration of mounting is hindered by slow aiming at positioning the chip to contacts.

The limit of evolution for used technology “aiming”



To get to the center of the target, it is necessary to aim.
It takes time.
How to get to the center instantaneously?

It was offered to create the aerial, which is the “target,” together with the installation of the chip to surface.

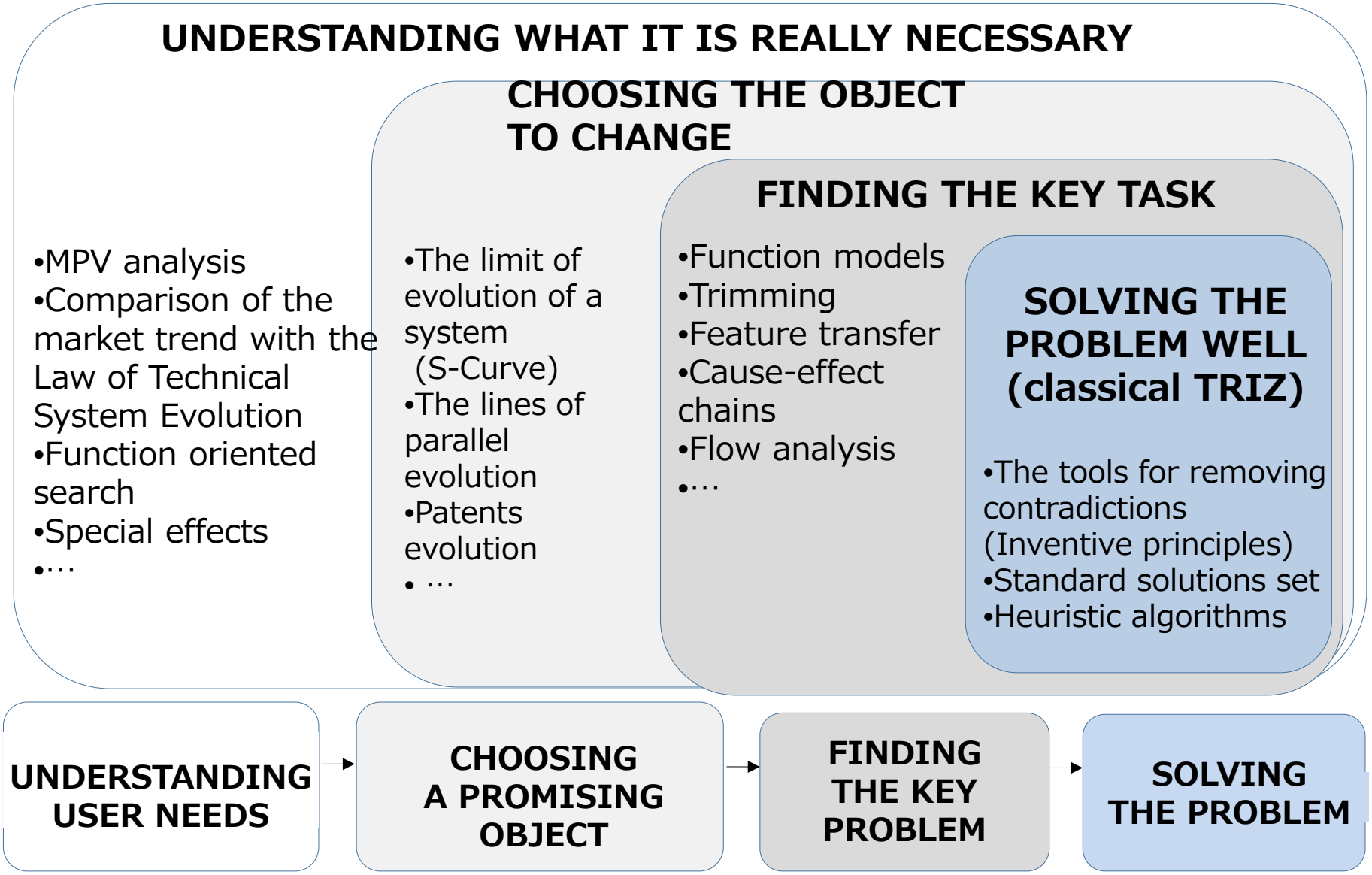


A new concept of mounting allowed to attain the problem of the project.

2000
TRIZ is a set of tools for revealing the evolution potential of objects and searching the ways for such evolution.

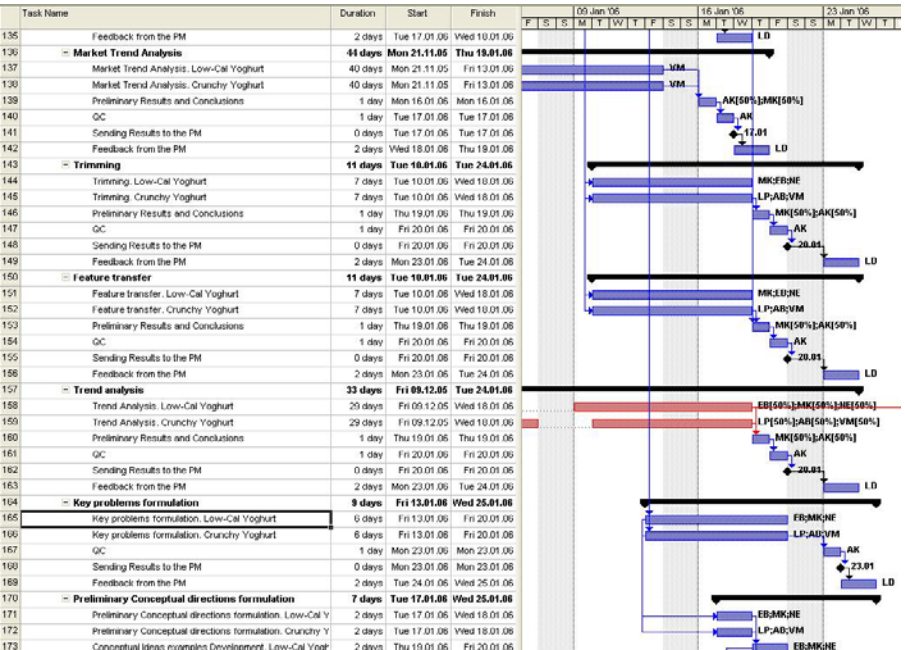
The types of problems:
Producing a strategy for further development
Choosing the characteristic for further development
Ascertaining the transition timing to a new action type

Modern TRIZ: REVEALING AND REALISING TRUE NEEDS



Why advanced companies use modern TRIZ version:

- A common language in which all the members that are tackling bilateral work can discuss the work process emerged
- Management and control of the process for concept search are possible
- Means for increasing the work efficiency at each intermediate step of the process exist
- New “program” competence, universal regarding development objects emerged



	Task Name	Duration	Start	Finish
135	Feedback from the PM	2 days	Tue 17.01.06	Wed 18.01.06
136	**Market Trend Analysis**	**44 days**	**Mon 21.11.05**	**Thu 19.01.06**
137	Market Trend Analysis. Low-Cal Yoghurt	40 days	Mon 21.11.05	Fri 13.01.06
138	Market Trend Analysis. Crunchy Yoghurt	40 days	Mon 21.11.05	Fri 13.01.06
139	Preliminary Results and Conclusions	1 day	Mon 16.01.06	Mon 16.01.06
140	QC	1 day	Tue 17.01.06	Tue 17.01.06
141	Sending Results to the PM	0 days	Tue 17.01.06	Tue 17.01.06
142	Feedback from the PM	2 days	Wed 18.01.06	Thu 19.01.06
143	**Trimming**	**11 days**	**Tue 10.01.06**	**Tue 24.01.06**
144	Trimming. Low-Cal Yoghurt	7 days	Tue 10.01.06	Wed 18.01.06
145	Trimming. Crunchy Yoghurt	7 days	Tue 10.01.06	Wed 18.01.06
146	Preliminary Results and Conclusions	1 day	Thu 19.01.06	Thu 19.01.06
147	QC	1 day	Fri 20.01.06	Fri 20.01.06
148	Sending Results to the PM	0 days	Fri 20.01.06	Fri 20.01.06
149	Feedback from the PM	2 days	Mon 23.01.06	Tue 24.01.06
150	**Feature transfer**	**11 days**	**Tue 10.01.06**	**Tue 24.01.06**
151	Feature transfer. Low-Cal Yoghurt	7 days	Tue 10.01.06	Wed 18.01.06
152	Feature transfer. Crunchy Yoghurt	7 days	Tue 10.01.06	Wed 18.01.06
153	Preliminary Results and Conclusions	1 day	Thu 19.01.06	Thu 19.01.06
154	QC	1 day	Fri 20.01.06	Fri 20.01.06
155	Sending Results to the PM	0 days	Fri 20.01.06	Fri 20.01.06
156	Feedback from the PM	2 days	Mon 23.01.06	Tue 24.01.06
157	**Trend analysis**	**33 days**	**Fri 09.12.05**	**Tue 24.01.06**
158	Trend Analysis. Low-Cal Yoghurt	29 days	Fri 09.12.05	Wed 18.01.06
159	Trend Analysis. Crunchy Yoghurt	29 days	Fri 09.12.05	Wed 18.01.06
160	Preliminary Results and Conclusions	1 day	Thu 19.01.06	Thu 19.01.06
161	QC	1 day	Fri 20.01.06	Fri 20.01.06
162	Sending Results to the PM	0 days	Fri 20.01.06	Fri 20.01.06
163	Feedback from the PM	2 days	Mon 23.01.06	Tue 24.01.06
164	**Key problems formulation**	**9 days**	**Fri 13.01.06**	**Wed 25.01.06**
165	Key problems formulation. Low-Cal Yoghurt	6 days	Fri 13.01.06	Fri 20.01.06
166	Key problems formulation. Crunchy Yoghurt	6 days	Fri 13.01.06	Fri 20.01.06
167	QC	1 day	Mon 23.01.06	Mon 23.01.06
168	Sending Results to the PM	0 days	Mon 23.01.06	Mon 23.01.06
169	Feedback from the PM	2 days	Tue 24.01.06	Wed 25.01.06
170	**Preliminary Conceptual directions formulation**	**7 days**	**Tue 17.01.06**	**Wed 25.01.06**
171	Preliminary Conceptual directions formulation. Low-Cal Y	2 days	Tue 17.01.06	Wed 18.01.06
172	Preliminary Conceptual directions formulation. Crunchy Y	2 days	Tue 17.01.06	Wed 18.01.06
173	Conceptual ideas examples Development. Low-Cal Yoght	2 days	Thu 19.01.06	Fri 20.01.06