Process of solving the inventive problems

Problem situation and the process of its improving

Problem situation and the process of its improving

The stimulus to technical perfection
is the understanding
that there is something **unsatisfactory**
in the present situation.

A problem situation
according to Genrikh Althsuller's definition:

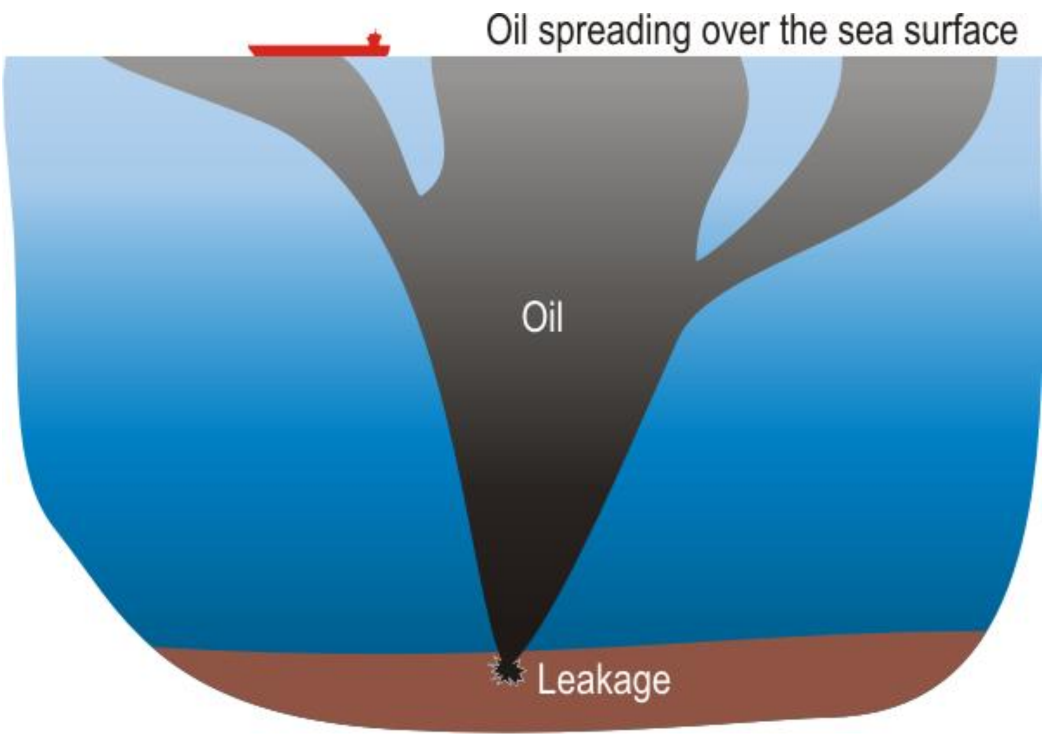
*"It's any technological situation
in which there is some definite
negative feature".*

The problem situation
is when at obtaining a useful function
performed by a technical system
simultaneously we obtain some negative phenomena,
i.e. **undesirable effects.**

Problem situation and the process of its improving

An example

An oil leakage in the oil well in the Gulf of Mexico and huge areas appeared to be polluted.



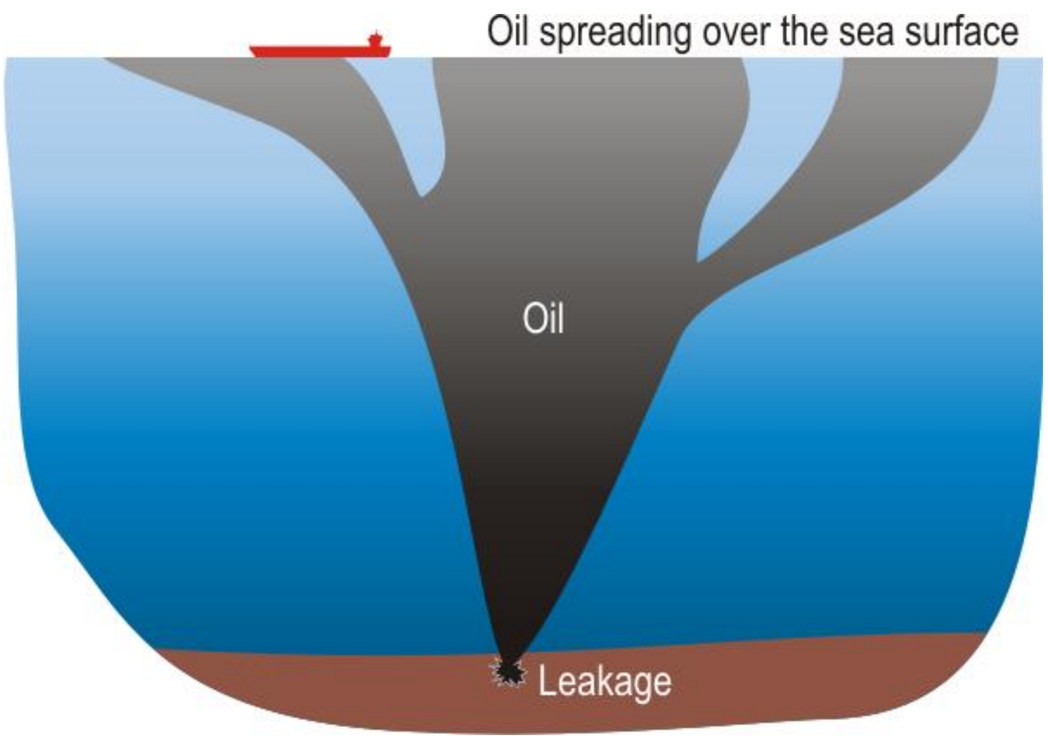
Key undesirable effects in this situation:

Oil flows out of the pipe

Oil spreads all over the sea surface uncontrollably

Problem situation and the process of its improving

An example



It was difficult to eliminate the leakage in the pipe quickly.
So, the primary task is
to prevent the **uncontrolled oil spillage**
in order to get some extra time to eliminate the leakage.

Problem situation and the process of its improving

In order to transfer from the problem situation to the problem formulation we should do a lot of analytical work which means to understand the reasons that led to appearing of the undesirable effect and which system parts require correction, to suggest hypotheses about the conditions of eliminating this undesirable effect. And a solved problem answers the question HOW to do the corrections and HOW to create these conditions.

Problem situation and the process of its improving

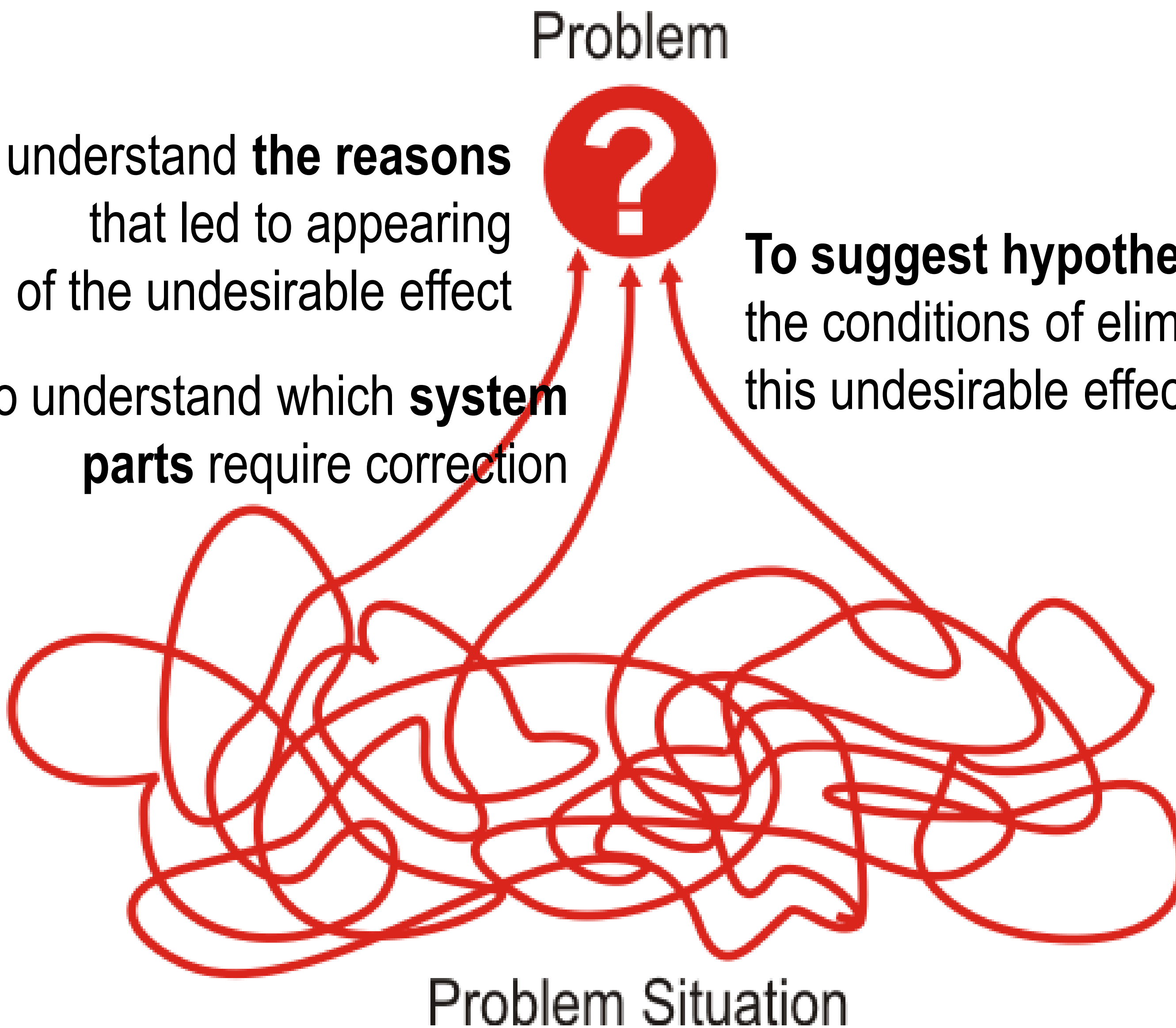
The problem can be solved by a traditional method, i.e. complex and expensive (and not always effective) or we could try to get into the sphere of strong solutions, which requires great intellectual effort, creativity and the ability to reveal and to resolve contradictions, to find unobvious resources and opportunities. Solving a problem on the inventive level presupposes the maximal approaching to the ideal final result, i.e. to obtaining of the desired result with the least expenses.

Problem situation and the process of its improving

To understand **the reasons** that led to appearing of the undesirable effect

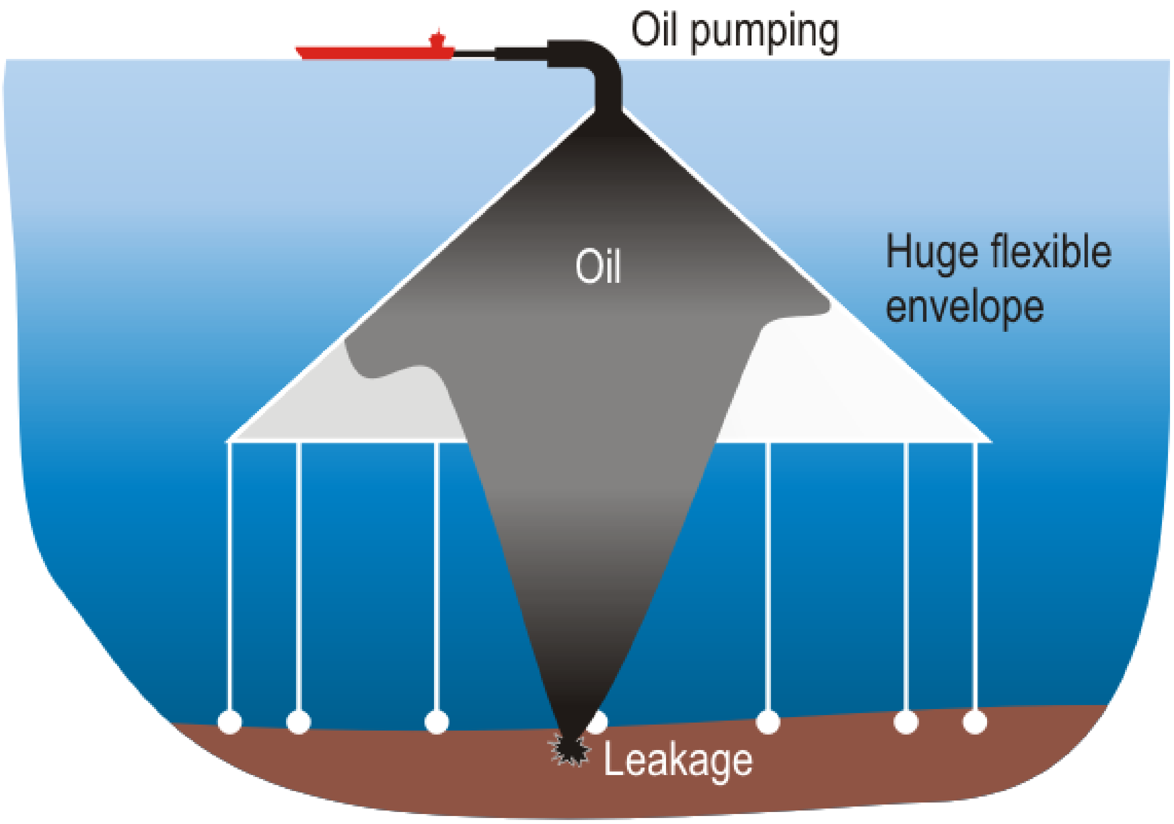
To understand which **system parts** require correction

To suggest hypotheses about the conditions of eliminating this undesirable effect.



Problem situation and the process of its improving

An example



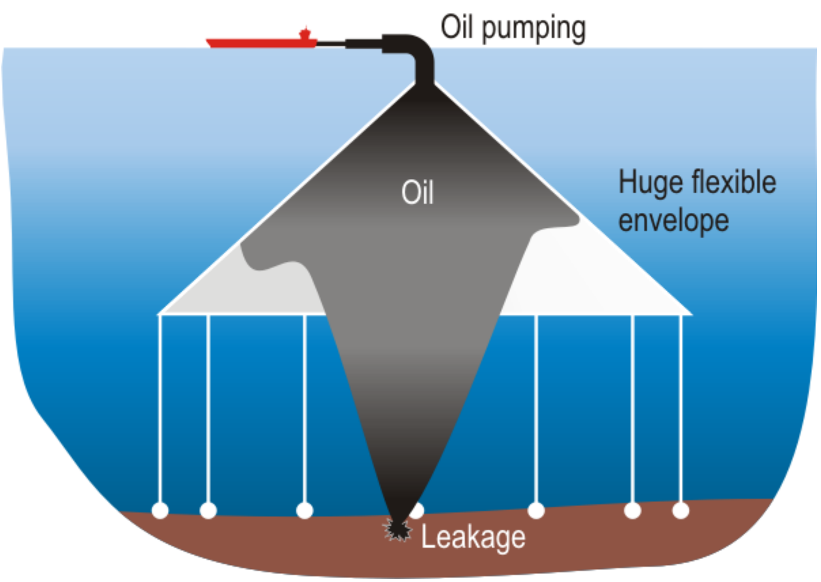
Possible solution:

To use a huge flexible envelope like a parachute canopy which would collect oil under water and prevent it from going out to the surface.

Further on,
we should turn
principal solution into a **technical** one
where we should take into account
all the peculiarities of real conditions.

Problem situation and the process of its improving

An example



Which should be the canopy **diameter**?

Which should be **the height** from the lower edge till the top?

How **deep** should the canopy be placed?

How to fix the envelope above the accident area?

How to pump the oil out of the canopy?

Problem situation and the process of its improving

“The process of solving an inventive problem: main stages and mechanisms”
(1975) by **Genrikh Altshuller.**

“We should clearly understand this chain:

situation- problem
– ideal solution
– physical solution
– technical solution
– calculated solution.”

Survey of algorithms for inventive activity support

Definition

The algorithm for solving inventive problems
is a predefined sequence of actions
followed by the solver
either to solve the problem
or to understand why this solution can't be obtained
and how to reformulate the problem
in order to get the positive result.

G.Altshuller mentioned that any inventive algorithm to have at least **three main points:**

IFR formulation

Revealing the contradiction

Using specifically **structured information** (inventive principles, effects, analogies and standard solutions)

Survey of algorithms for inventive activity support

Algorithms of inventive problem solving

can **partially** or **completely**

support the process of improving a problem situation.

ARIZ-85

(The Algorithms of Resolving Inventive Problems, version of 1985)

ARIZ-CMVA-91

by Boris Zolotin and Alla Zusman

ARIZ-91

by specialists from St. Petersburg

EST

("Effective Solution Technology")

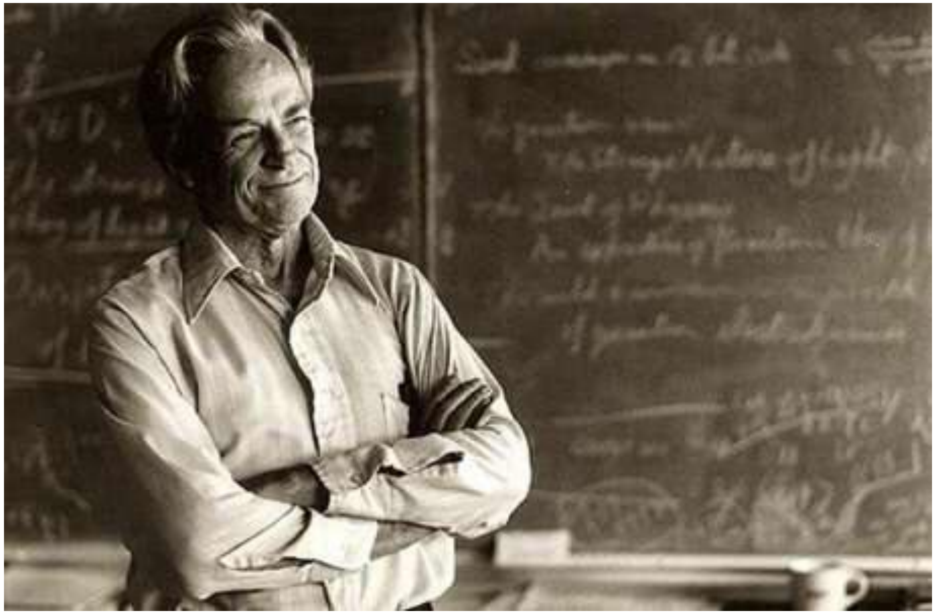
by Alexey Podkatilin

AEPC

(Algorithm of Engineering Problem Choice)

by Gennady Ivanov and Alexander Bystritskiy

The algorithms differ in their **complexity.**



The simplest algorithm by a famous physicist Richard Feynman:

1. Write down the problem statement

2. Think it over well.

3. Write down the solution.

Survey of algorithms for inventive activity support

Simplified algorithms

USIT

(Unified Structured Inventive Thinking)

ASIT

(Advanced Systematic Inventive Thinking)

Specified and formalized algorithms

ARIZ-85

(9 parts and 40 steps)

ARIZ-CMVA-91

(18 parts and 90 steps)

ASP-2009(TP)

(The Algorithm of Solving Production and Technological Problems)
detailed instructions, rules,
action performance variants and pieces of advice for each step,
interconnections between the steps

Common problems

for the majority of the inventive algorithms

1.

Satisfactory problem solving isn't guaranteed.

2.

The analytical and solving methods
have been developed in the inventive and innovation sphere
are often left beyond inventive algorithms.

3.

Algorithm logic is unfamiliar
for specialists of a production team.

Requirements to "an ideal" algorithm

1.

It should cover the whole work process
aimed at improving the problem situation.

2.

It should be easily studied.

3.

It gives us a hint **which methods**
and **when to use** and **which result** should be obtained.

4.

It isn't strict.

5.

It is **universal** as it allows solving
both complex and simple problems..

The Algorithm of Improving Problem Situations (AIPS)

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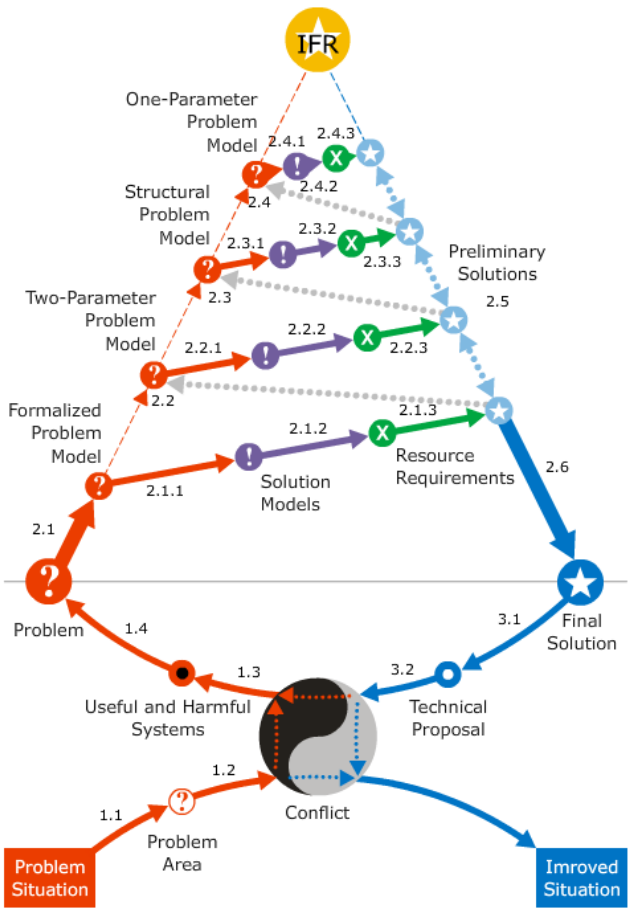
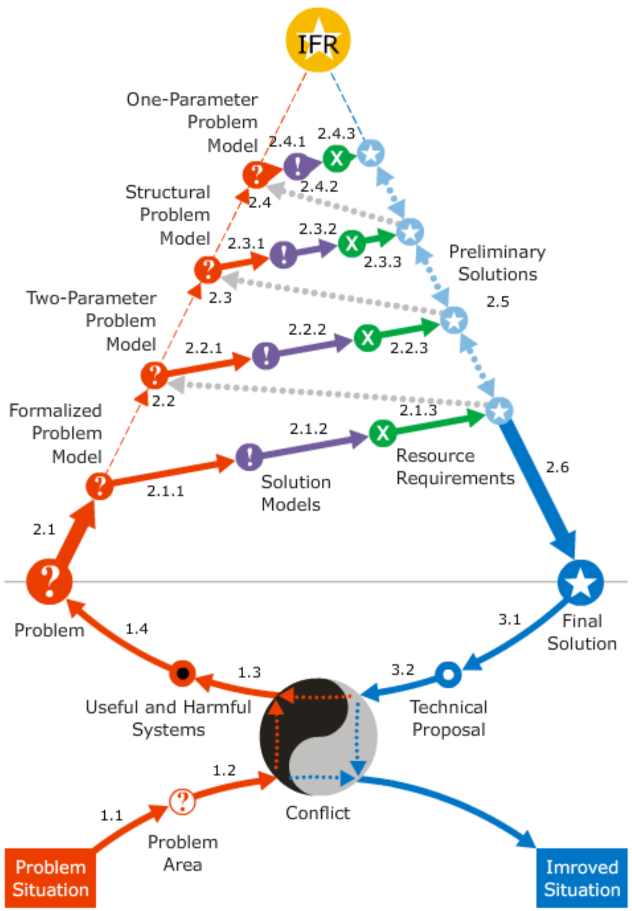


The Algorithm is designed to help a solver to organize his thinking process while solving a problem.

targetInvention

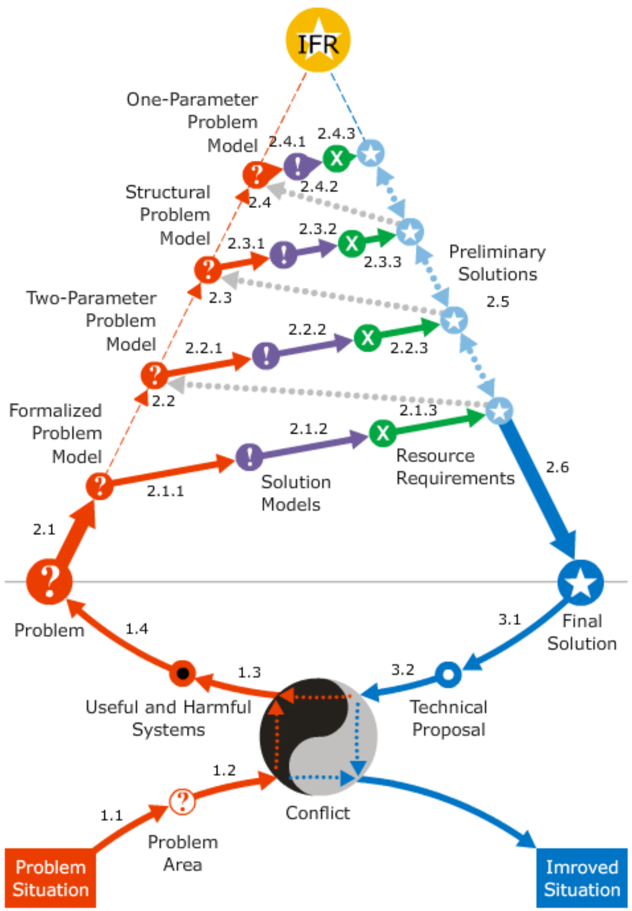
The Algorithm of Improving Problem Situations (AIPS)



The Algorithm logic does not contradict the natural course of thought but allows a better control of it.

targetInvention

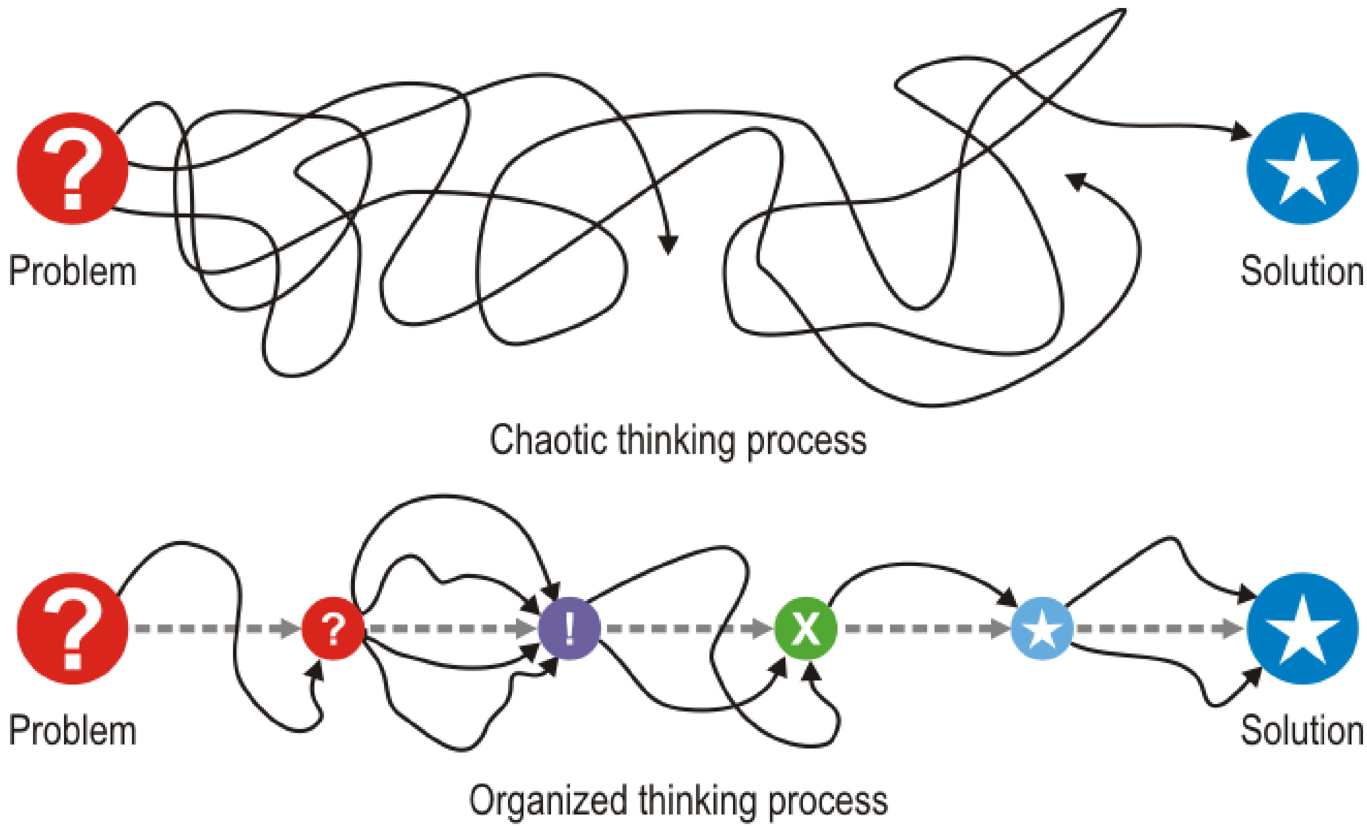
The Algorithm of Improving Problem Situations (AIPS)



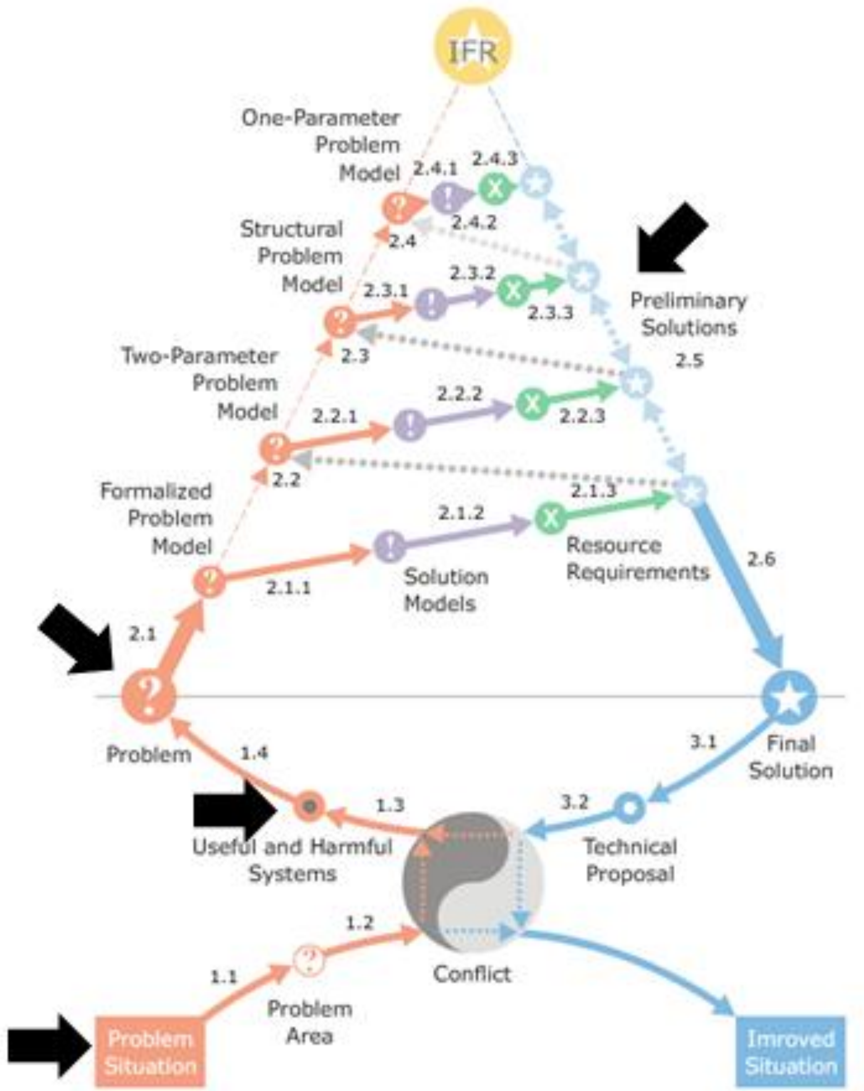
Simple and clear graphic presentation contributes to its easy study.

The Algorithm of Improving Problem Situations (AIPS)

The Algorithm changes
a continuous and **chaotic** thinking process
into **a distinct sequence** of discrete steps.



The Algorithm of Improving Problem Situations (AIPS)

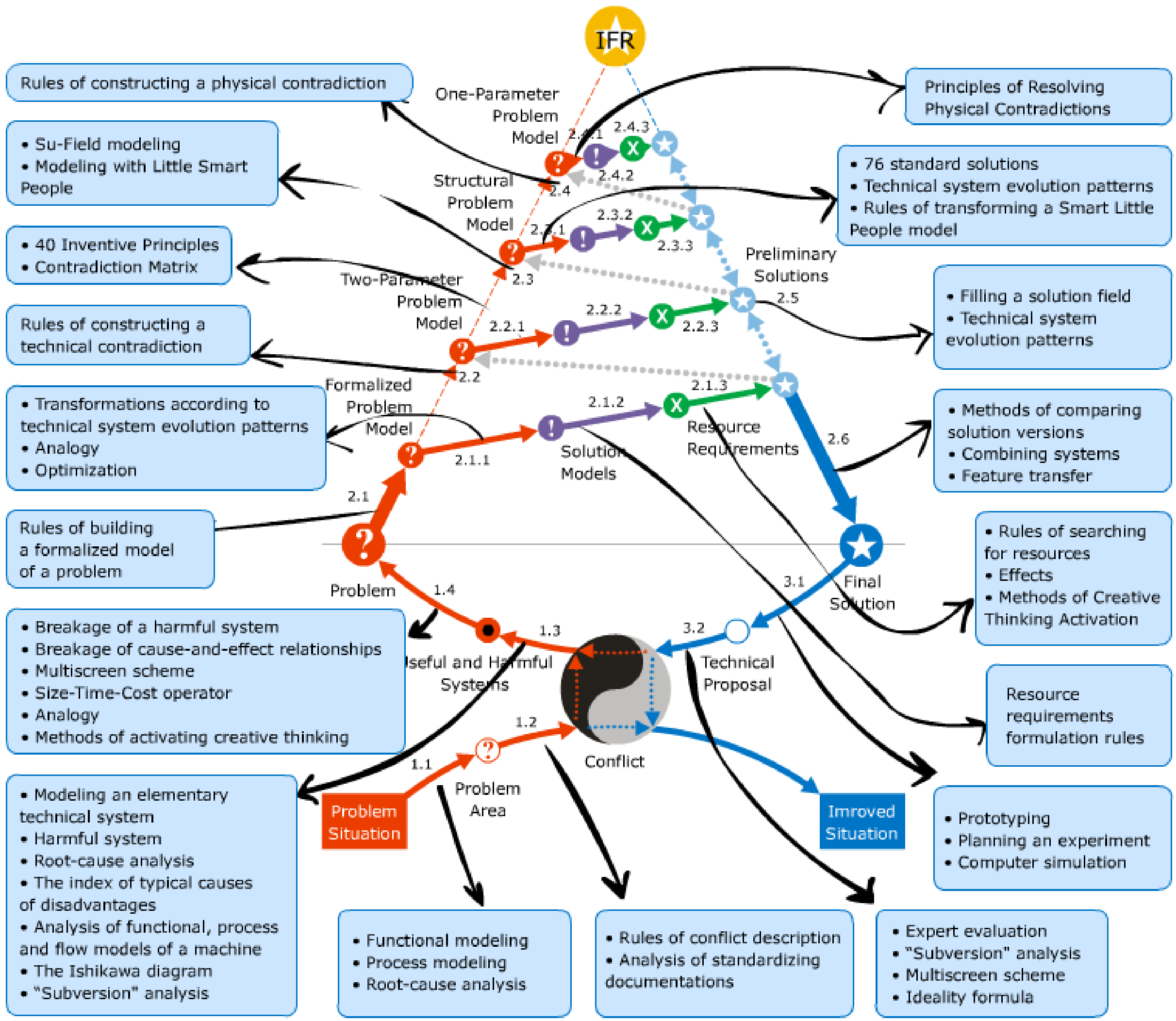


A thinking process preserves **flexibility.**

The Algorithm has **several enter points.**

The problem solving work **can be finished** as soon as a satisfactory solution has been obtained.

The Algorithm of Improving Problem Situations (AIPS)

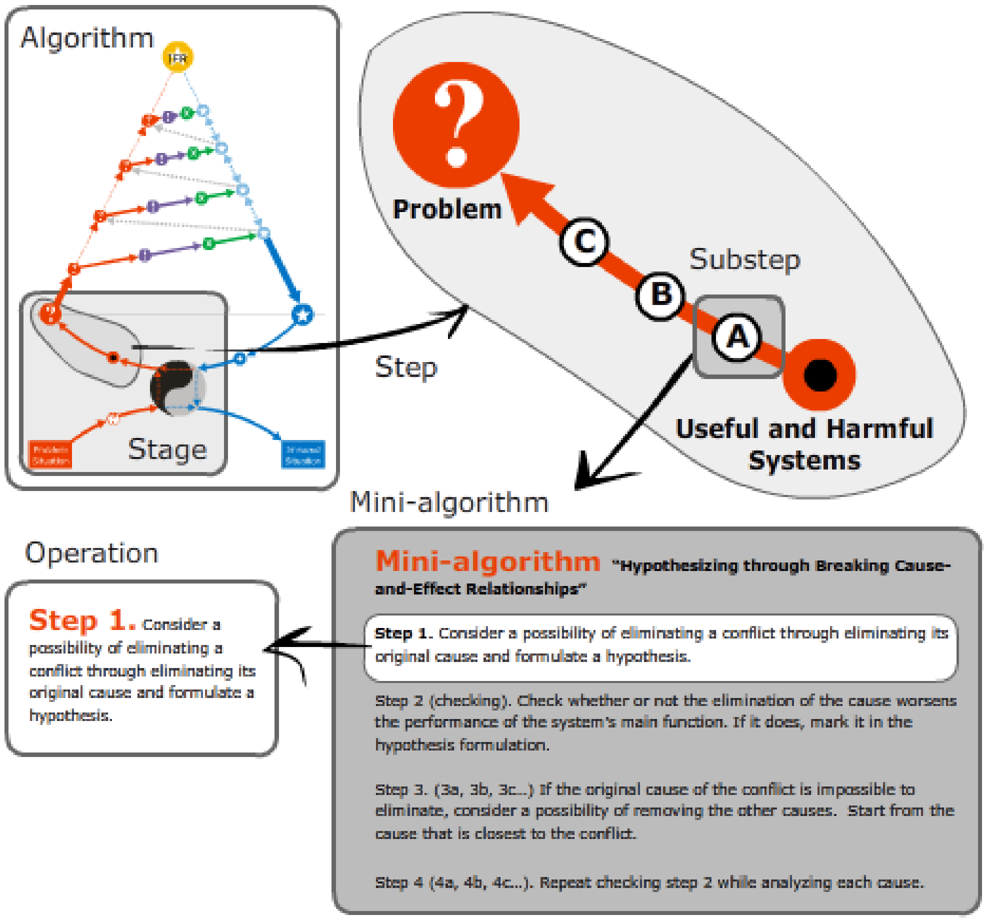


The Algorithm organizes analytical and solving methods into **an integrated system.**

The Algorithm of Improving Problem Situations (AIPS)

A chain is produced:

algorithm — stage — step — substep — mini-algorithm — operation.

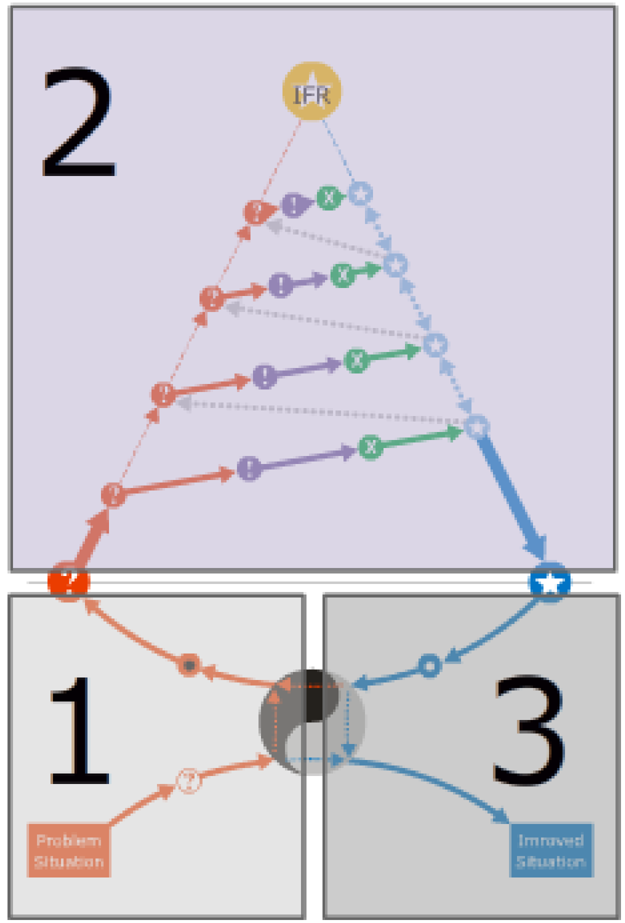


The Algorithm offers support to a solving process at all levels starting from the strategic to the operational one.

Algorithm logic

Algorithm logic

Stage 2
Solving
a problem



Stage 1
Analysis
of a problem
situation

Stage 3
Analysis
of a changed
situation

Stage 1. Analysis of a problem situation

We should

find a problem area which causes all troubles

understand **the inner causes** of this disadvantage

and determine **the possibilities**
we could use in order **to eliminate it.**

Stage 2. Problem solving

We clearly formulate **what result we want to get** and what prevents it.

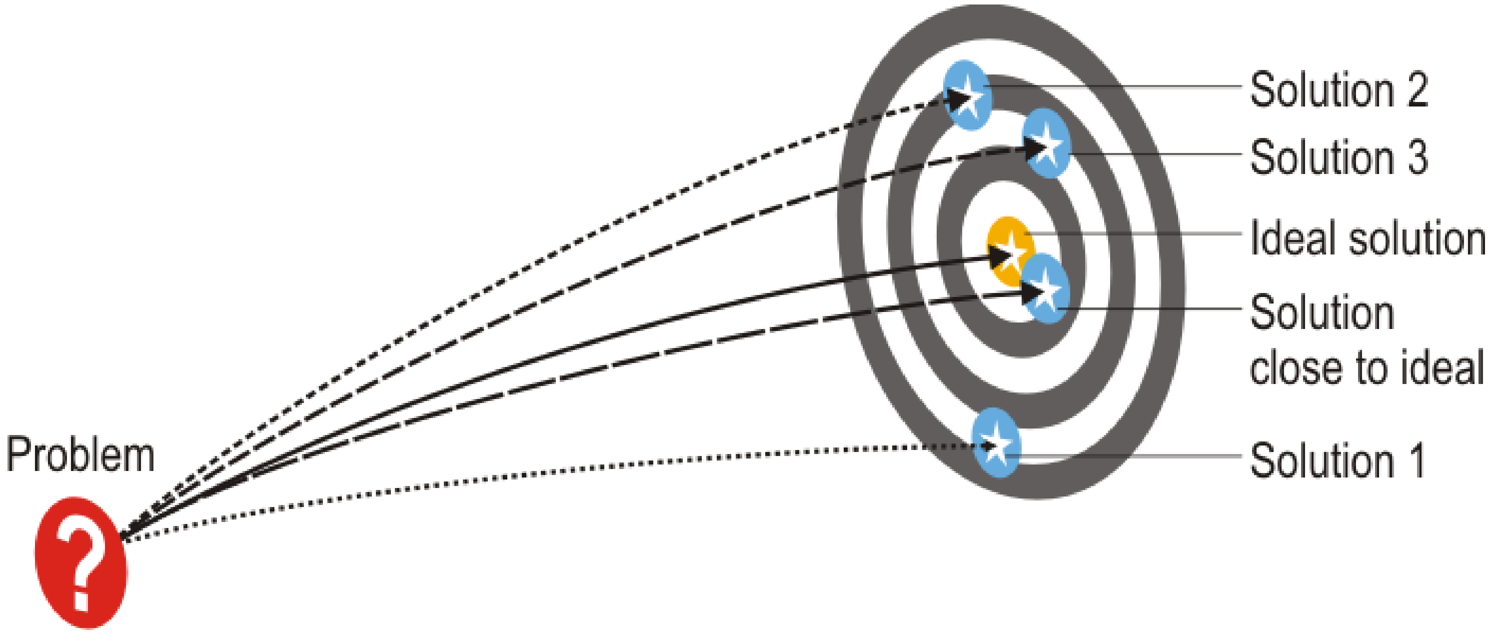
We find **a key idea** how to obtain the required result.

We think over **what we need** to implement this idea and **which recourses** allow us to use this idea for improving a specific machine.

We **find the recourses** and transform this idea into **a real solution.**

Stage 2. Problem solving

The best way to solve the problem is to do it by **"ranging"** method.



targetInvention

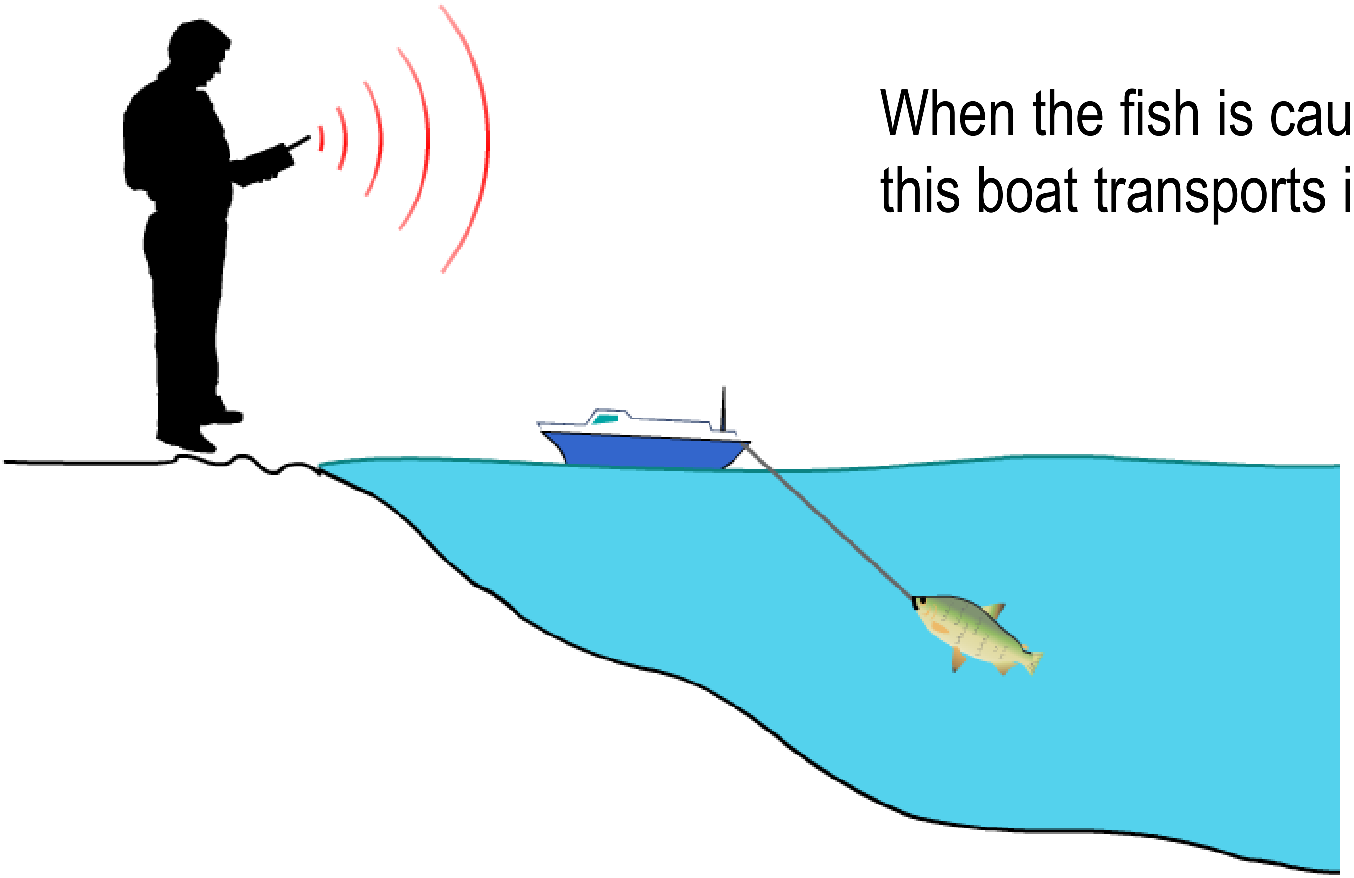
Stage 3. Analysis of a changed situation

When the final solution is obtained
we should **check its efficiency.**

The solution idea is turned
into **a real machine.**

Example.
A radio-controlled fishing

Example. A radio-controlled fishing

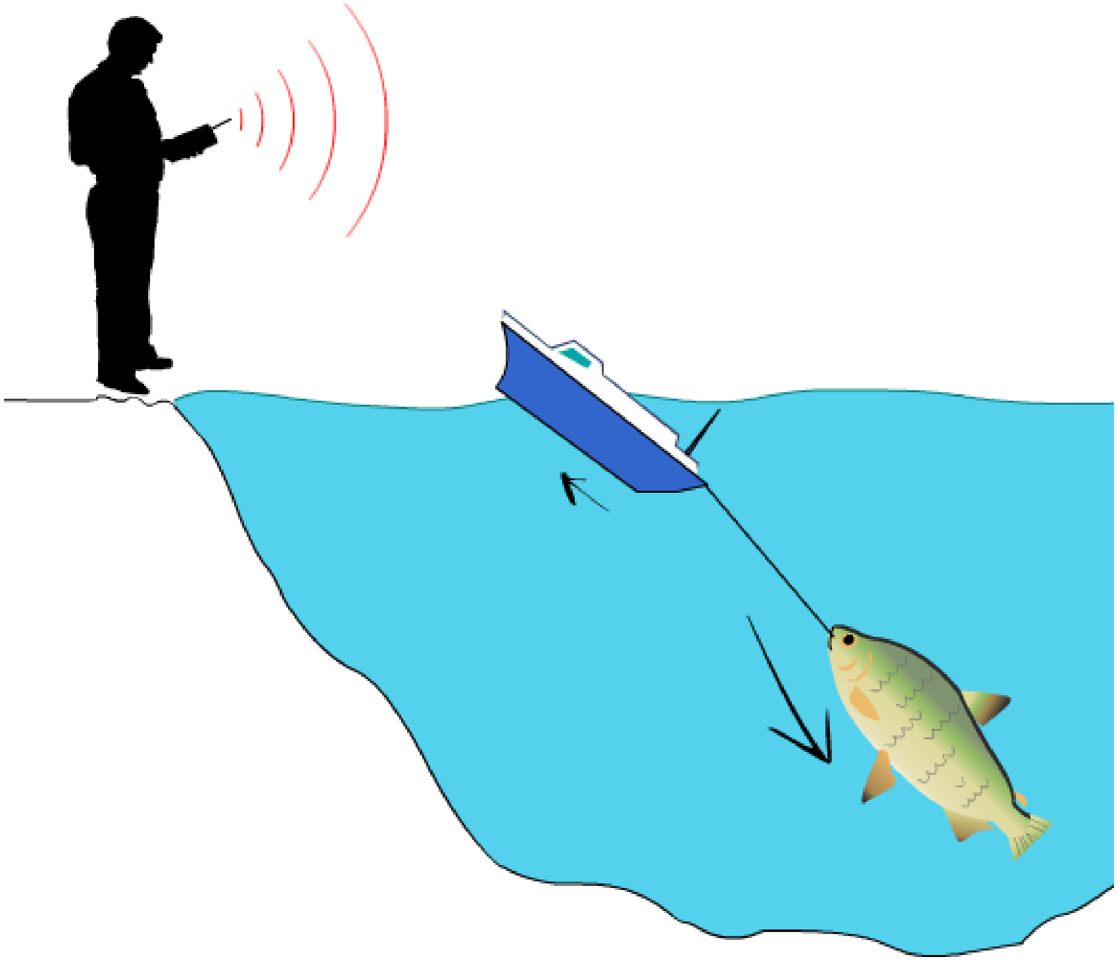


A boat carries the bait with the desired speed and in any place of a water basin.

When the fish is caught, this boat transports it to the bank.

Example. A radio-controlled fishing

Stage 1. Analysis of a problem situation



The conflict appears when the fish is too big.

The conflicting components: the big fish and the boat sunk by fish.

The conflict cause: boat can't overcome fish resistance.

Stage 2. Problem solving

A solution:
To install a more powerful motor on the boat.

Disadvantages:
A powerful motor will be bigger in size
and we should enlarge the boat itself.

A powerful motor works louder and that scares the fish.

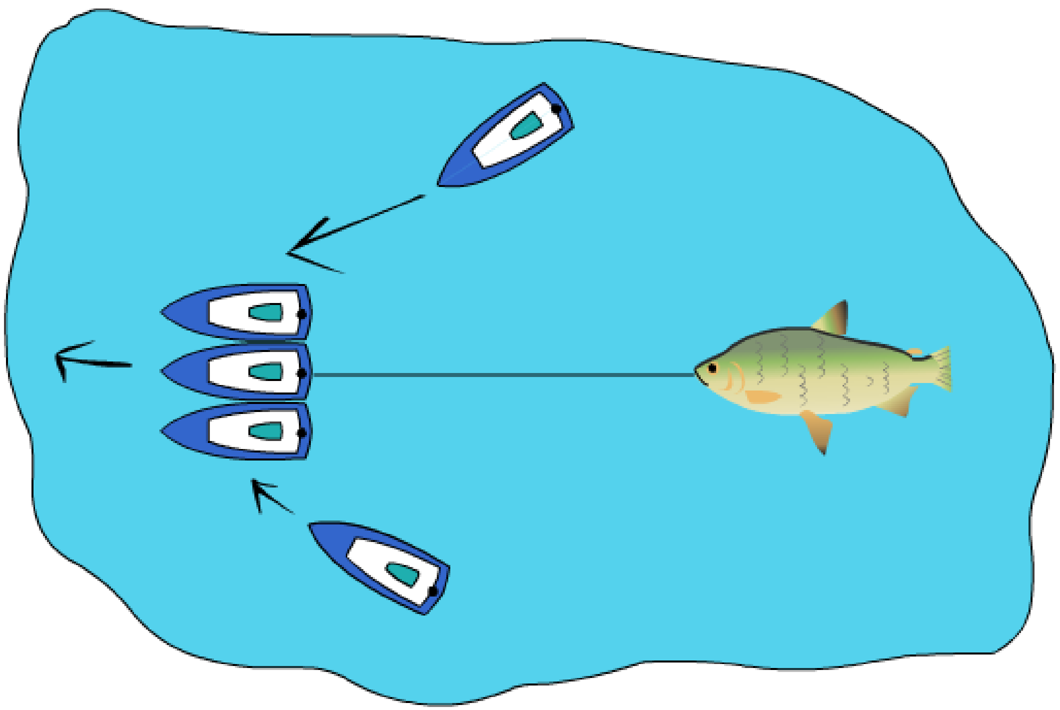
Stage 2. Problem solving

A technical contradiction:
by increasing the boat **power**
we increase its size and **noisiness.**

Here it’s possible to use
an inventive principle
“Merging”.

Example. A radio-controlled fishing

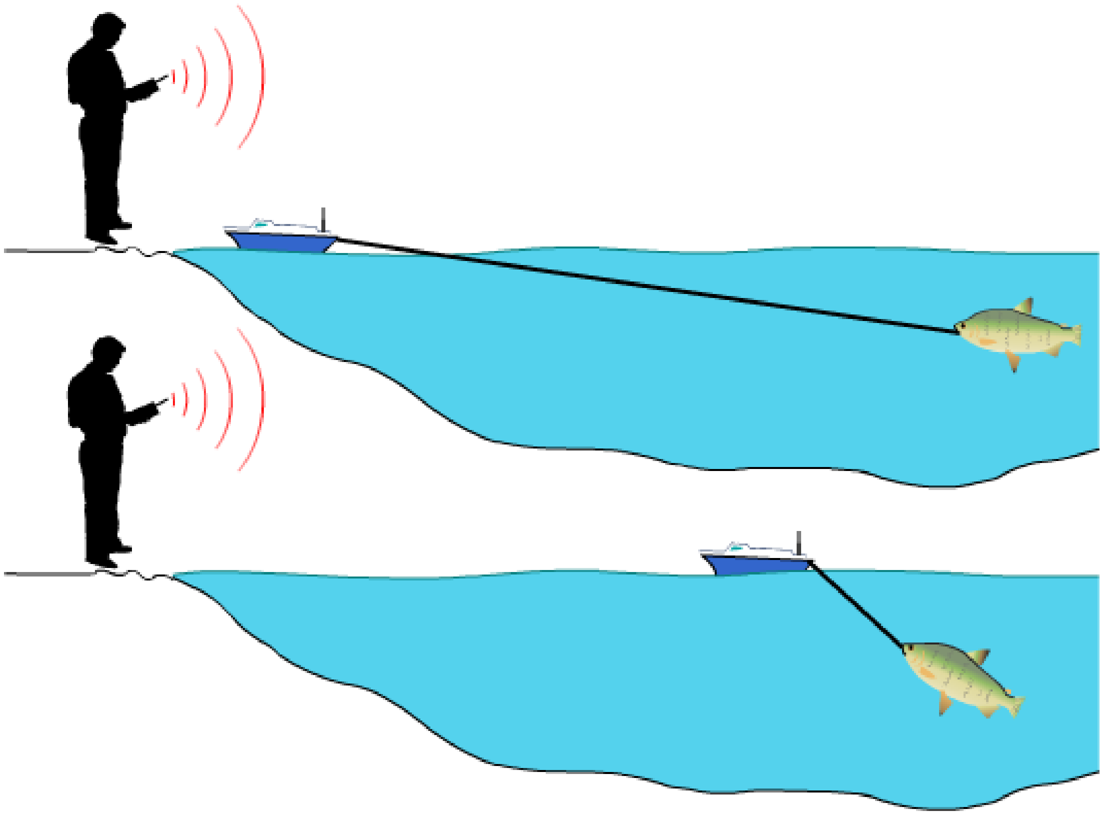
Stage 2. Problem solving



A solution:
To use se several low-powered boats which can group and carry the fish out together.

A disadvantage:
Greatly complicating the system.

Stage 2. Problem solving

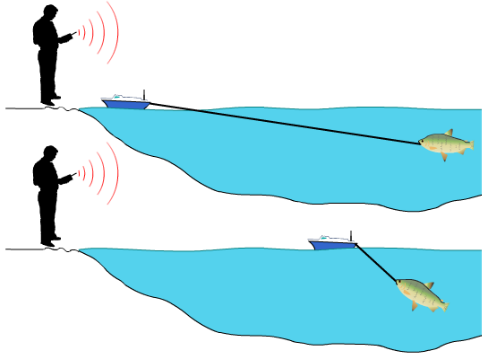


A physical contradiction:

The fishing line should be **long** and should be **short** at the same time.

Example. A radio-controlled fishing

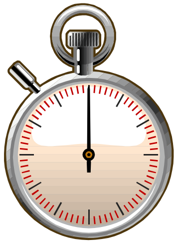
Stage 2. Problem solving



A solution:

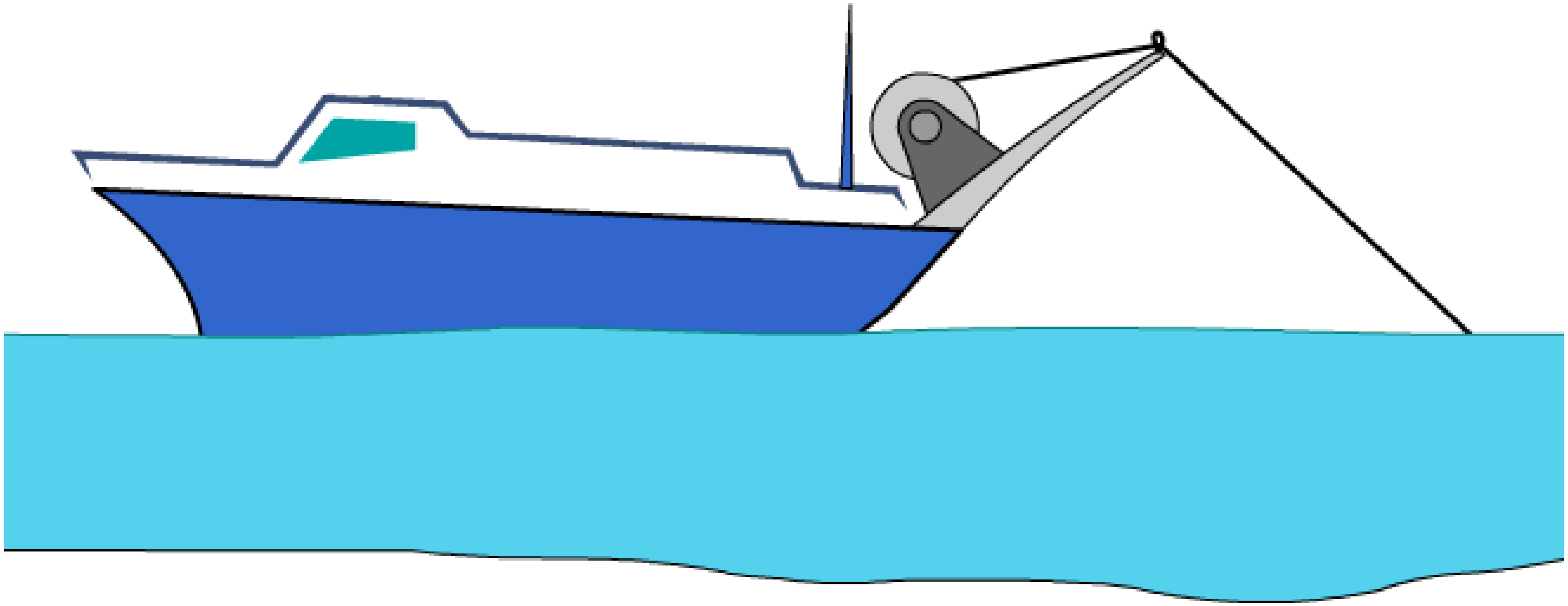
Let the fishing line be short while the boat "tempts" the fish with the bait.

When the fish bites, the fishing line should easily stretch.



Stage 3. Analysis of a changed situation

The device construction
to realize the idea



The end of the lecture