# TRIZ Case study

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**Object of study** is coffee-machine system.  
**Key system function** is to cook and serve coffee drinks.  
**Different types of coffee machines** (Table 1.1.). Different types are hybrids of other types so can perform multiple functions.

Table 1.1. Coffee machines types

|  |  |
| --- | --- |
|  | Cafetiere (френч-пресс) |
|  | Cezve (turkish coffee, ту́рка, джезва) |
|  | Drip brewing machine, фильтр-кофе: сhemex (ке́мекс), капельная кофеварка, Пуровер (воронка) |
|  | Moka pot (гейзерная кофеварка) |
|  | Vacuum machine (габет, вакуумный или балансирный сифон, венская сифонная машина) |
|  | Coffee percolator (кофейный перколятор) |
|  | Espresso machine (Кофеваaрка эспреtссо, рожковая кофеварка, или эспрессо-машина) |
|  | Coffee vending machine (кофейный автомат) |

Some of a high level functional elements together with corresponding functions are represented in the Figure 1.1.

A close up of a map

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Figure 1.1. Functional model of a coffee machine

Table 1.2. Multi-screen system operator for coffee machine system

|  |  |  |  |
| --- | --- | --- | --- |
| Note: Subsystems in brackets are considered as optional | | | |
| **Time**  **Hierarchy** | **Past** | **Present** | **Future** |
| **Super-system** | Coffee distribution point | Coffee distribution point | Coffee distribution point |
| **System** | Manual and Semi-automatic coffee machine which is usually relates to a certain coffee machine type | Automatic electric coffee machine which combines different coffee machines types | Robotic coffee machine which combines different types of coffee machines |
| **Subsystems** | - Ground coffee beans - Water container - Raw coffee container - Filter - Coffee drink container - Heater - Coffee grinder  - Coffee ingredients pipes - Manual force (operator) | - *Ground coffee beans* - *Water container* - *Raw coffee container* - *Filter* - *[Coffee drink container]* - *Heater* - *Coffee grinder*  - *Coffee ingredients pipes* - *Manual force (operator)*  - Waste container  - Cups container  - Electro-mechanical part  - Computer programs - [Graphical “press-button” interface]  - Payment machine | - *Ground coffee beans* - *Water container* - *Raw coffee container* - *Filter* - *Heater* - *[Coffee grinder]*  - *[Coffee ingredients pipes]*  - *[Waste container]*  - *[Cups container]*  - *Electro-mechanical part*  - *Computer programs*  - *Payment machine*  - Natural language interface  - Robot-operator |
| **Solved problems** | - Tool to cook coffee drinks using expert knowledge and skills to cook  - Separate tool aimed to cook only one kind of coffee drink | - Able to cook very limited hardcoded set of coffee drinks types in one place  - Cook coffee drinks partly with human intervention  - Coffee machine is able to sell coffee drinks by itself | - No manual force needed  - Consumer uses natural language interface to order coffee drinks and get information and consultation about coffee drinks |
| **Unsolved problems** | - Eliminate manual force in cooking process  - Use one tool to cook all kinds of coffee drinks  - Operator has to sell coffee drinks by himself | - Eliminate manual force in cooking process, so no human needed to fill up raw coffee material, clean coffee machine, serve/deliver coffee drinks  - Cook any kind of coffee drinks which is put into the machine memory  - Provide an ability to experiment with new kinds of coffee drinks, create recipes in machine memory  - Get information and consultation about coffee drinks  - Identify consumer and cook coffee drinks using personalized recipes | - Make robots to do a maintenance of a coffee machine |

1. Define an anti-system for the selected system

**Action**: cook coffee drink.

**Reverse action**: split coffee drink on constituent substances  
**Useful hybrid system**: coffee machine is able to split coffee drink on constituent substances and do a chemical analysis to provide information about a volume of fats, proteins, carbohydrates, caffeine, sugar, calories, providing personal recommendations.

1. Analyze the situation, draw the cause diagram and detect requirements contradiction(s).   
   Note: You can use RCA+ or Ishikawa diagram, or other method.

A close up of a map

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1. Define the requirements contradiction, detected on the diagram in the form (known solution, requirement, and undesirable effect)

A screenshot of a cell phone

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**Object** is coffee machine.

**Object property** is size. If the size is big then there will be a lot of coffee and no need to fill in raw materials too often. If the size is small then coffee machine occupies a little space but can serve a few cups of coffee drinks.

1. Define the requirements contradiction in terms of TRIZ Matrix (parameter to increase, decreased parameter)

**Parameter to increase**: action time (activity time).  
**Decreased parameter**: ease of use.

1. Describe a solution based on the selected TRIZ methods (TRIZ table of methods)

**#15** – Dynamization (Динамизация)

**#19** – Periodic actions (Периодические действия)

**#27** – Cheap fragility (Дешёвая недолговечность)

**#29** – Fluidity (Текучесть)

1. Define the property contradiction (the object, property, property value to meet the requirement, and the property value to prevent undesirable effect)

A close up of a map

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1. Describe the operational zone for the property contradiction

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1. Describe the operational time for the property contradiction

A screenshot of a cell phone

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1. Define available resources

|  |  |  |
| --- | --- | --- |
| Resources of conflict | Environment resources | Super-system resources |
| Raw materials containers | Plumbing | Coffee consumer |
| Raw materials | Coffee bean warehouse | Neighboring shops |
| Time to cook coffee drink | Rubbish chute |  |
|  | Shared space |  |

**IFR**: raw materials container must be populated by coffee machine; coffee machine must produce no waste.

1. Solution idea(s)

Use shared plumbing to supply water, so no need of water container (*fluidity*). Use shared rubbish chute so no need to of waste container (*fluidity*). Create coffee pipe from neighboring coffee shops and warehouses (*fluidity*).

Recycle used grounded coffee beans to make cups (*dynamization*, *cheap fragility*, *periodic actions*) between or during coffee drinks cooking.