TRIZ Case study

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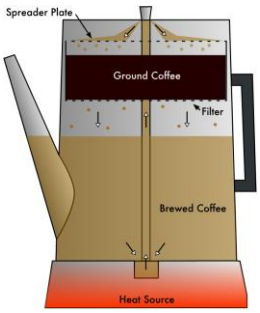
Object of study is coffee-machine system.
Key system function is to cook and serve coffee drinks.
Different types of coffee machines (Table 1.1.). Different types are hybrids of other types so can perform multiple functions.

Table 1.1. Coffee machines types

	Cafetiere (френч-пресс)
	Cezve (turkish coffee, ту́рка, джезва)
	Drip brewing machine, фильтр-кофе: chemex (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 (Кофеваарка эспретссо, 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.

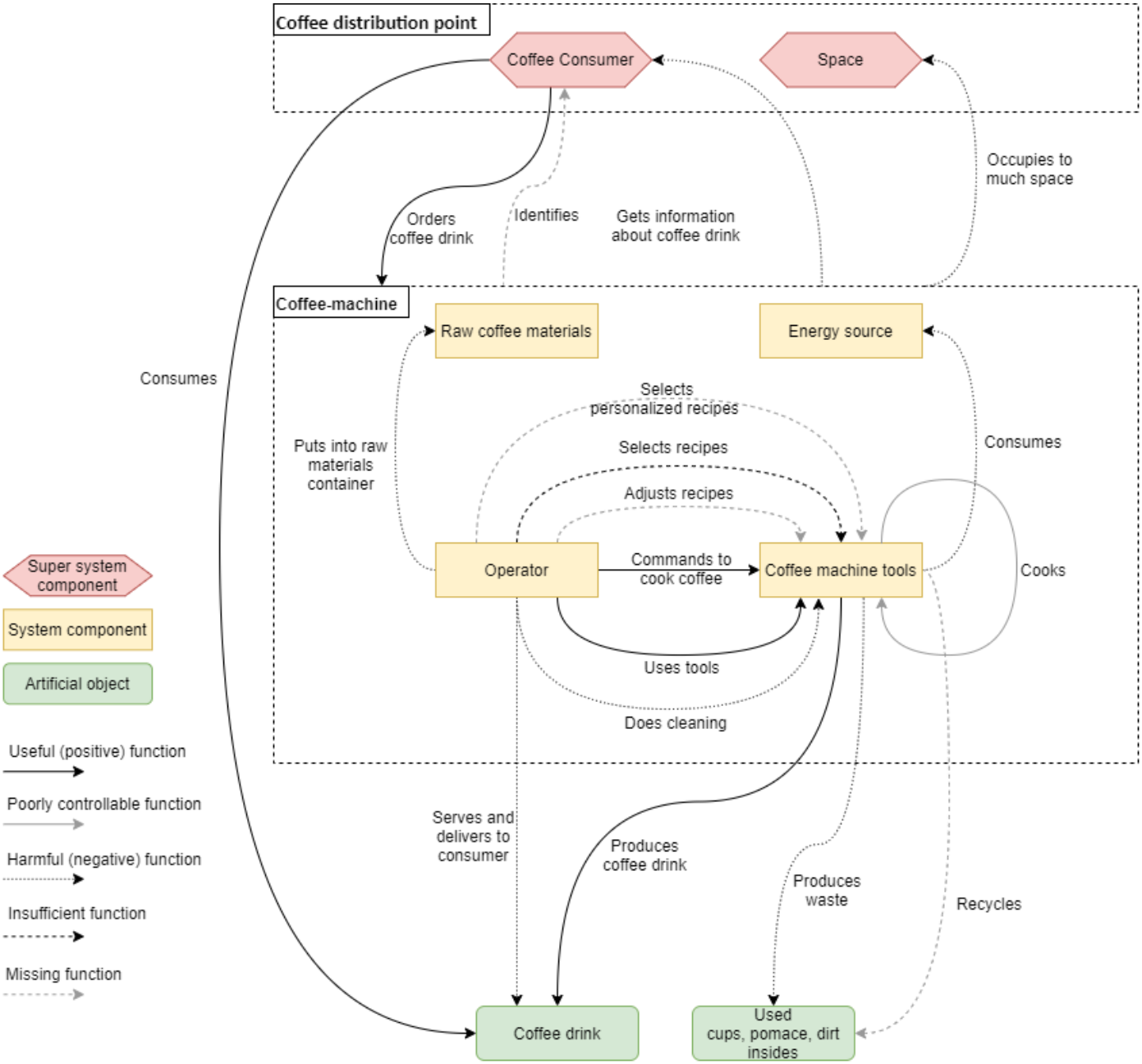


Figure 1.1. Functional model of a coffee machine

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

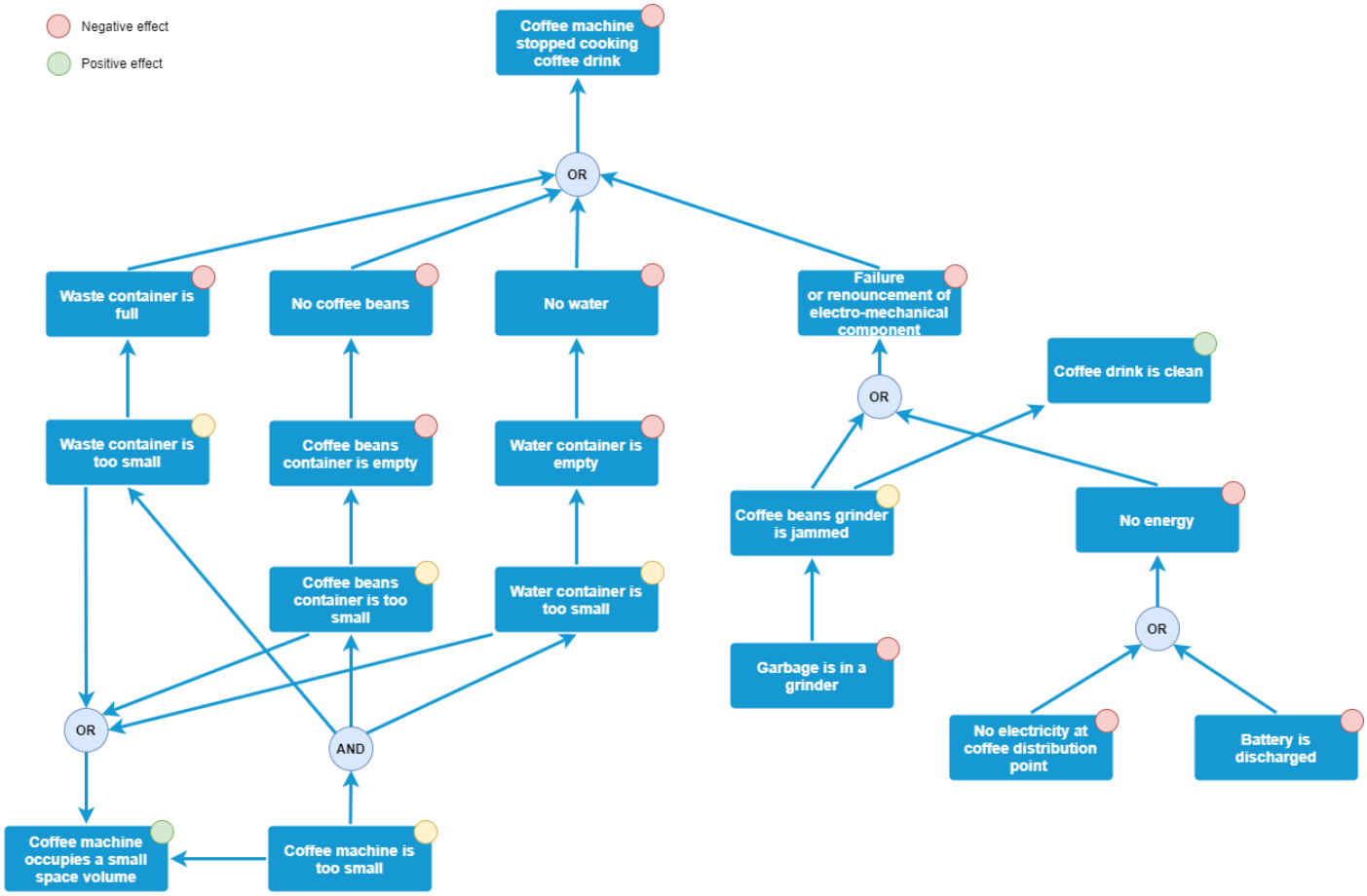
System	Manual and Semi-automatic coffee machine which is usually relates to a certain coffee machine type	Automatic electric coffee machine which combines different coffee machines types	Robotic coffee machine which combines different types of coffee machines
Subsystems	- Ground coffee beans - Water 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

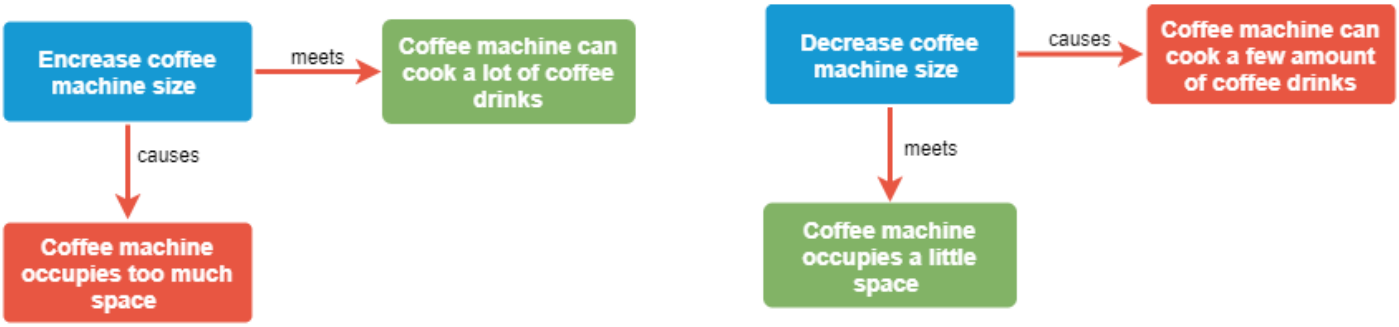
Action: cook coffee drink.
Reverse action: split coffee drink on constituent substances
Useful hybrid system: coffee machine is able to split coffee drink on constituent substances and do a chemical

analysis to provide information about a volume of fats, proteins, carbohydrates, caffeine, sugar, calories, providing personal recommendations.

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



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



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.

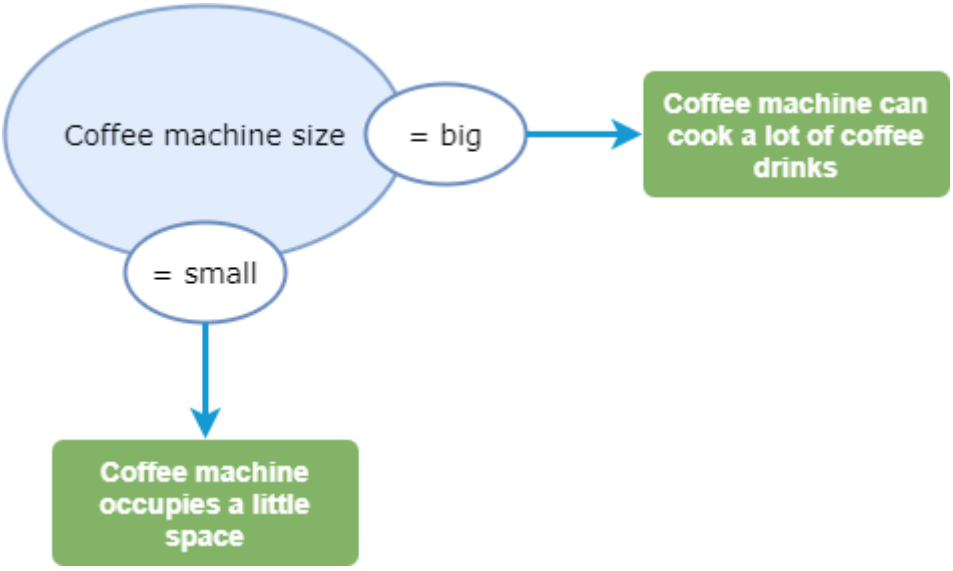
4. Define the requirements contradiction in terms of TRIZ Matrix (parameter to increase, decreased parameter)

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

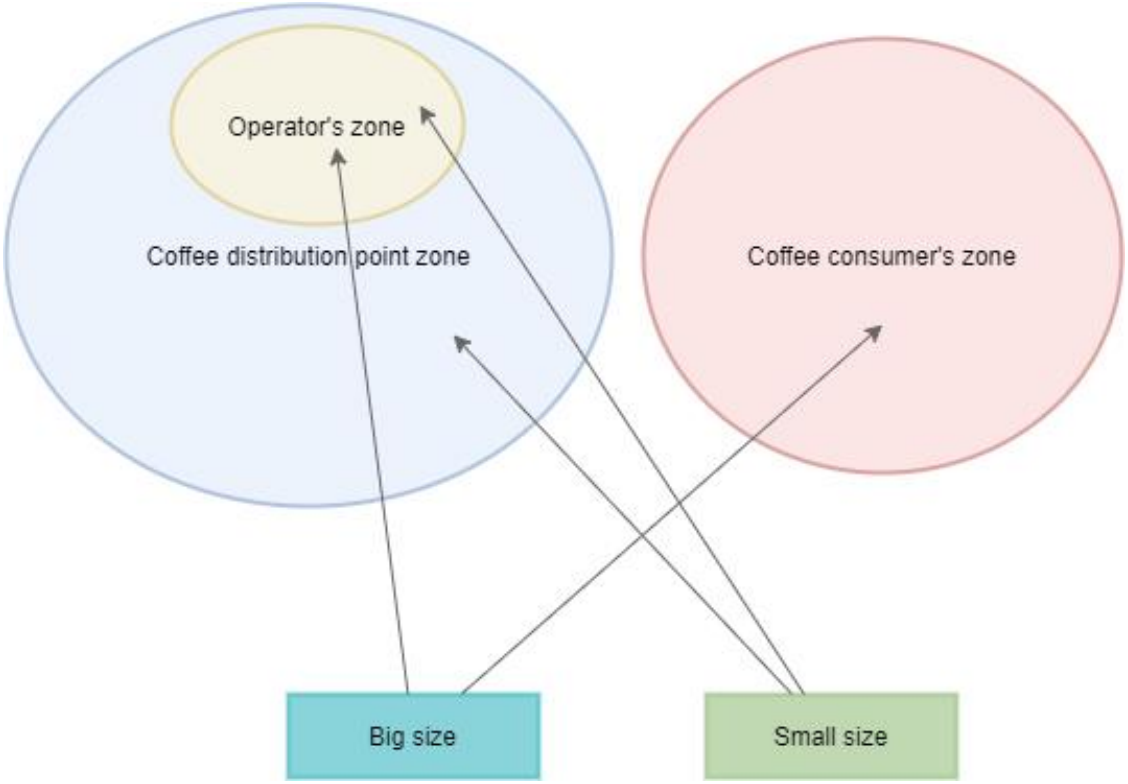
5. Describe a solution based on the selected TRIZ methods (TRIZ table of methods)

#15 – Dynamization (Динамизация)
#19 – Periodic actions (Периодические действия)
#27 – Cheap fragility (Дешёвая недолговечность)
#29 – Fluidity (Текучесть)

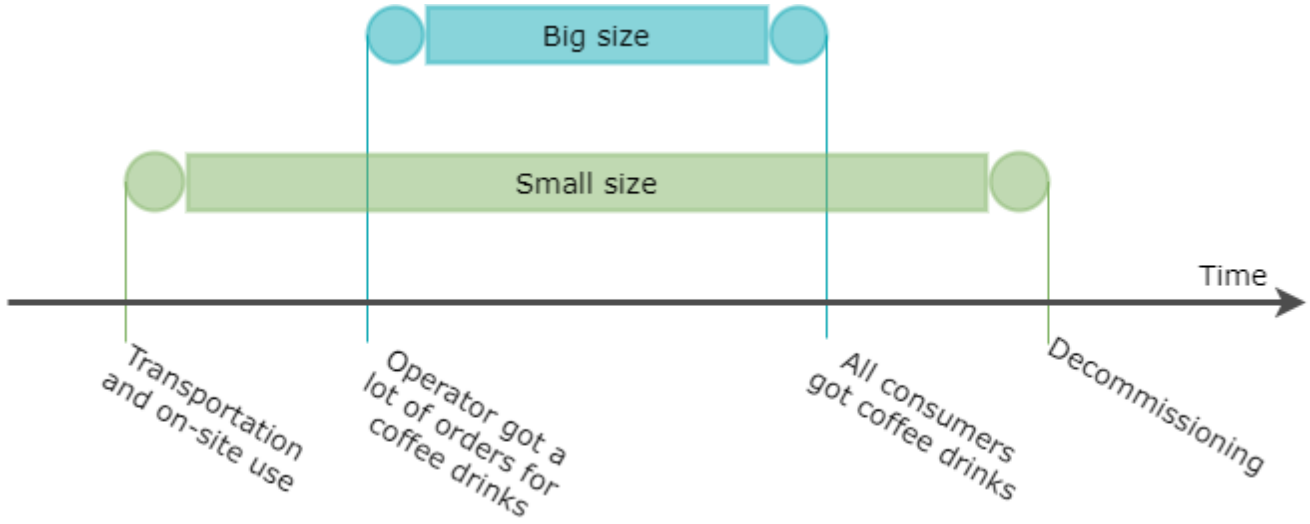
6. Define the property contradiction (the object, property, property value to meet the requirement, and the property value to prevent undesirable effect)



7. Describe the operational zone for the property contradiction



8. Describe the operational time for the property contradiction



9. 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.

10. 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.