

Modelling Sustainable Systems and Semantic Web

Modelling Contradictory Requirements in TRIZ

Lecture in the Module 10-202-2309
for Master Computer Science

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Notion of a Technical System

(V. Petrov, 2020)

A **system** is a set of *elements* which are *interconnected* and *interact with each other*, which form a *unified whole* which has *properties* that are not already contained in the constituting elements considered individually.

Such a property is referred to as a **system effect**, **synergy**, or **emergence**.

Synergy is the overall effect of the interaction of two or more factors, characterised by the fact that this overall effect clearly exceeds the effect of each of the components and their simple sum.

TS as Reduction to the Essential

The reduction to the essential ...

... focuses on the following three dimensions:

- (1) Delimitation of the TS from the outside against an *environment*, reduction of this relationships to input/output relations and guaranteed throughput (Purpose and ability to work).
- (2) Delimitation of the TS from the inside by grouping parts as *components*, reducing their functioning on a "behavior control" via their interfaces.
- (3) Reduction of the relationships in the TS itself to *causally essential* ones.

Technical Systems and Antecedence

The TS in the World of Technical Systems

The description of a TS is only possible based on descriptions of other (explicitly or implicitly given) TS. The description is anteceded ...

- (1) ... by a vague idea of the (working) input/output characteristics of the environment.
- (2) ... by a clear understanding how the components work beyond their pure specification.
- (3) ... by a vague idea of cause and effect relationships in the system itself, that precedes the detailed modeling.

Components and Objects

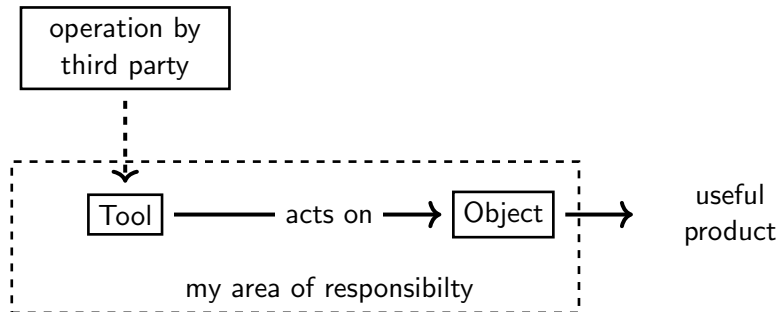
(Szyperski 2002)

- ▶ Components are again systems.
- ▶ They can be self-developed or purchased from third parties.
- ▶ It is not necessary to purchase the whole component, it is sufficient to use the *service*.

This happens in many cases: A component is available in the system with its functional specification as a black box, the operation of the component (provision of the function) is carried out by a third party, out of *their* area of responsibility, the function has an effect on "my" objects in *my area of responsibility*.

- ▶ Thus the distinction according to Szyperski: components encapsulate functionality, objects encapsulate system states.

The Minimal Technical System in TRIZ



Dotted frame = the minimum technical system

Dotted arrow = is addressed in Szyperski, but not in TRIZ

Components and Environment

Components (especially those operated by third parties) are thus pointers to other places in the *world of technical systems* and thus represent only another form of the "relationship of a system to the environment".

The question arises whether aspects (1) and (3) in the list of the "reductions to essential" (component and neighboring system) can be unified in such a way.

On the other hand, the question arises how to incorporate the concept of the object into the overall logic.

We will leave both questions open at this point.

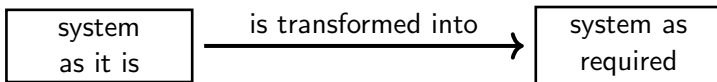
Modelling of Systems

Two problems:

- (1) Build a new system
- (2) Transform an existing system

(1) can be considered as a special case of (2), since any need for a new system comes with at least *rough ideas* about that new system, thus also under (1) there is at least a *rough description form* of the system to be created as antecedence.

Modelling of Systems



This basic scheme fits not only technical systems, but also the modelling of social, socio-ecological and cultural systems, hence it is sufficiently universal.