Modelling Sustainable Systems and Semantic Web

Systems and Development

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

Prof. Dr. Hans-Gert Gräbe

http://informatik.uni-leipzig.de/~graebe

Modelling Systems

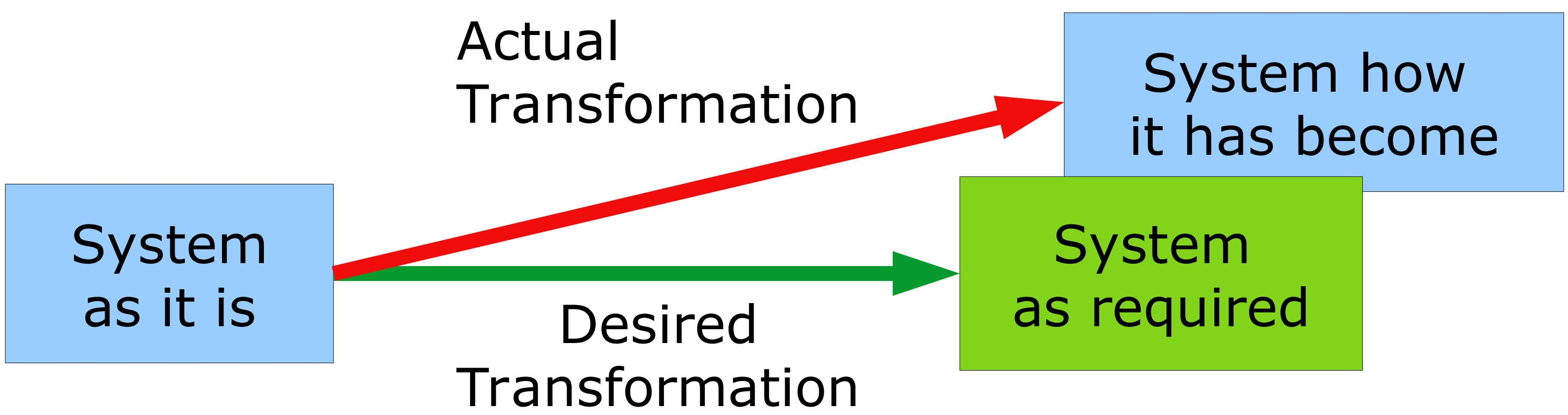
Two problems:
(1) Build new system
(2) Rebuild existing system

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

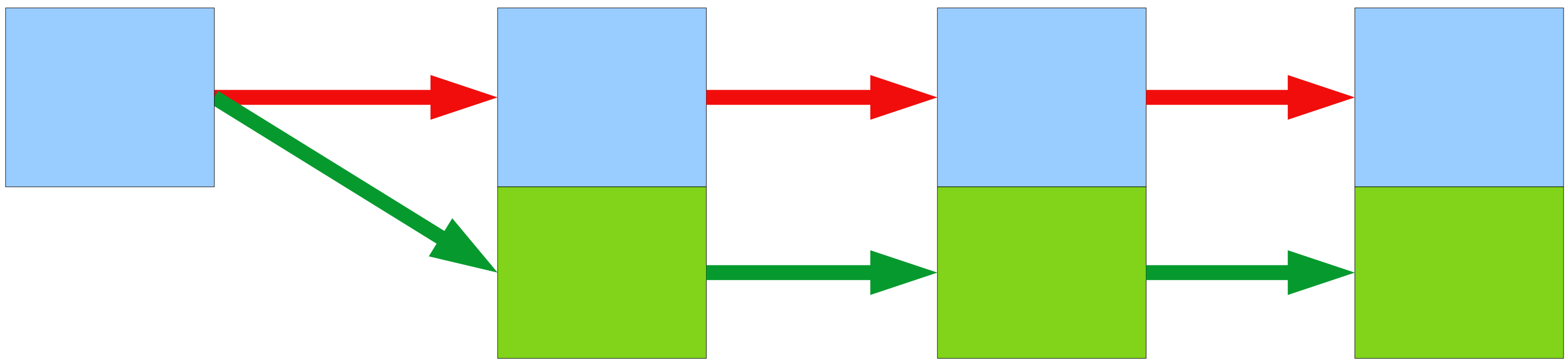
Modelling Systems

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

How does such a system evolve over time?



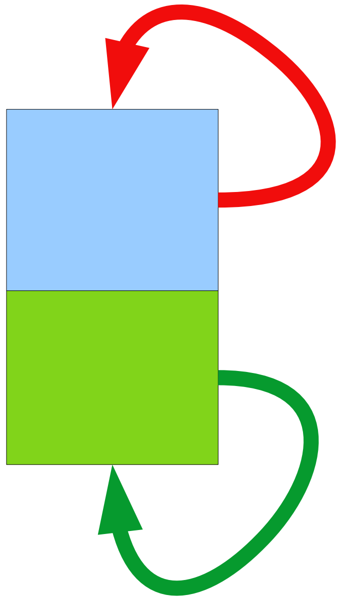
Systems Development



Transitional development as *different versions* of the system over the time.

But can also be understood as development in time of *the same system*.

Transitional management versus adaptive management.



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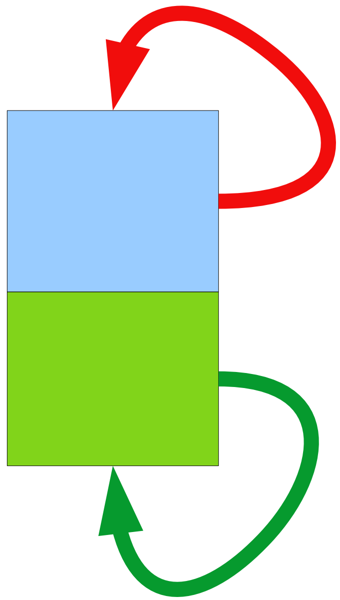
The development of a system can therefore be conceived as a contradiction between an *ideal line of development* and a *real line of development*.



This idea is reflected in the TRIZ concept of the *Ideal Final Result* (IFR).

In the (mathematical) *Theory of Dynamical Systems* (TDS), system development is conceived as a progression of states, which can be described by functions f(t) with values in a phase space.

The *ideal behaviour* is described by mathematical relation-ships, such as differential equations, whose invariant solutions describe a partial structure of stable states (*trajectories*) in phase space.

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These differential equations and trajectories are part of the *description form of the system* and thus have already been created by *reduction to essentials*.

In the modelling it is assumed that everything essential is taken into account, i.e. that the *real temporal development* r(t) of the system differs from the *ideal temporal development* f(t) only by a small difference d(t)=r(t)-f(t), which *is insignificant for the selected essential*.

While f(t) enables a *quantitative prediction* of the development of the system, the statement that d(t) is "small" or "damped" is a *qualitative statement* of the descriptive form.

Often one also restricts oneself with f(t) to a *qualitative statement* about the exact position of the trajectories as invariants in the solution space and thus to the statement that r(t) oscillates around these trajectories in a damped manner. These trajectories seem to "magically" attract the real states and are therefore also called *attractors*.

For example, the Earth moves on an elliptical orbit around the Sun in the sense that real deviations from this orbit are always compensated for.

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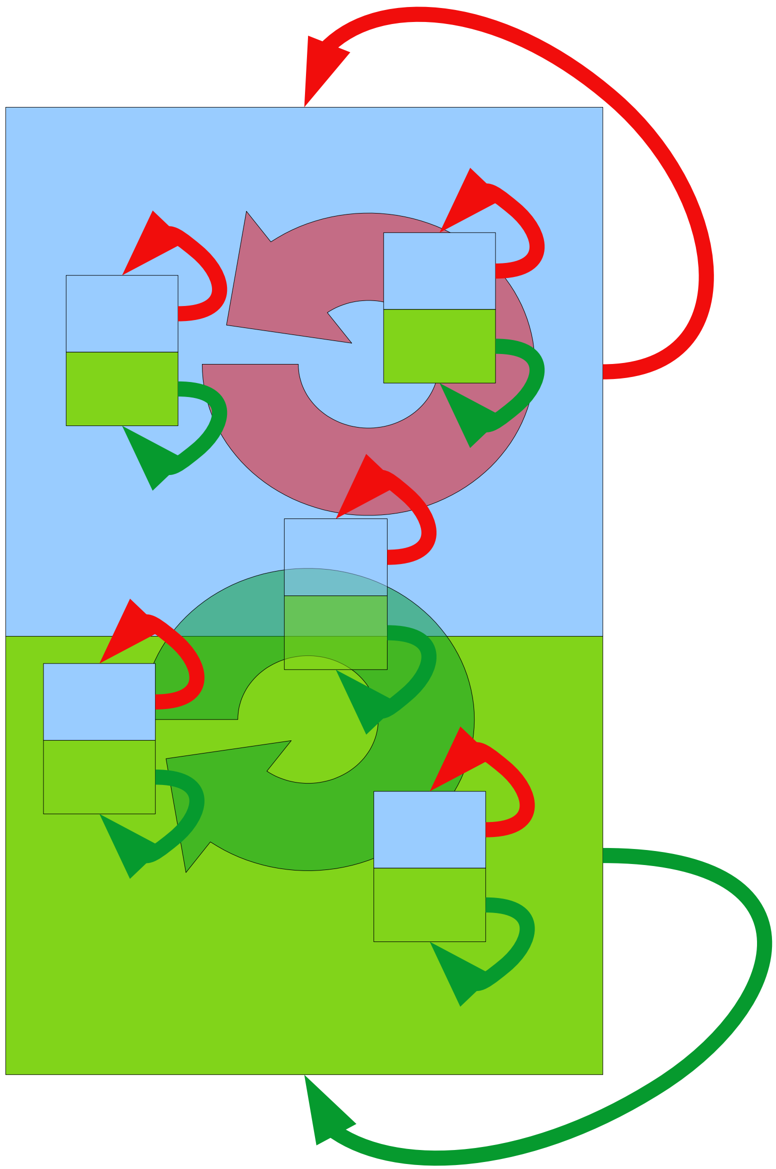

Development

- of the system itself
- the components in the system and
- the relationships in the system

However, let us first take a closer look at how complicated trajectories can be.

See TDS.md