

A Holistic Dynamic Classification Framework for Software Estimation

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Abstract:

The many facets of software estimation demand an orientation framework for knowledge organization. Since holistic thinking is no longer a foreign word in many organizations, a framework for classification based on Popper's Tree World Model was developed by the author. Furthermore the dynamic approach of Systems Theory was applied to this classification framework, realized in form of cybernetic circuits. This holistic dynamic classification framework (HDCF) can be used as an orientation schema for all aspects of themes relative to software estimation.

The HDCF consists according to the first development process of twelve parts – three for each world of Popper and for each of these four for the 4 elements of a cybernetic circuit (i.e. Measurement Link (Meßglied), Governor (Regler), Adjustment Link (Stellglied) and Regulating Extension (Regelstrecke). To each of these 12 parts of the model, the keywords of software estimation are attached. This leads to a holistic overview of the software estimation world.

The advantage of the model is that the 12 parts of the HDCF can be identified by the intention of the 3 worlds of Popper and the 4 elements of a cybernetic circuit. This leads to a dynamic usage of the model. Both concepts will be introduced in order to give the user the possibility to use this concept for orientation and classification.

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A Holistic Dynamic Classification Framework for Software Estimation

By Manfred Bundschuh, President of DASMA e.V.

1. Introduction

Thinking holistically isn't a foreign word any longer in many organizations. Nevertheless many organizations find it difficult to disseminate this kind of thinking within middle and lower management. It often penetrates no further than to the middle management. Therefore it's often forgotten that every employee has to make his contribution to it.

There are lots of activities in organizations that could enable dissemination of this new kind of thinking into the organizations. Very helpful is the model of Popper's three worlds, a model of knowledge organization which ensures that all possible aspects of a theme in respect to that three worlds are covered, structured and/or categorized holistically.

2. Popper's three worlds

Popper's cognition model delivers the following definitions:

World 1:

The physical world of material things – “that, which is the case” (Wittgenstein)

In the case of our theme (i.e., software estimation) we relate our knowledge (**know what**) as well as physical database and professional work to this world 1 – summarized: **estimation**.

World 2:

The world of human experience

This means for our theme the pitfalls and human aspects of resistance which we observe in our daily application as well as our heuristic-strategic knowledge (**know why and know how**) of estimation – summarized: **administration of estimation**; i.e., acquisition, storage, distribution, evaluation and usage.

World 3:

The world of products of human spirit

For our theme we do understand as world 3 all our collected insights into the processes of estimation and our values and ability to evaluate (**care why**) – summarized: **management of estimation**; i.e., politics, goals and principles.

Fig. 1: Popper's Three World Model

In reality there is of course no division of this three aspects of life – it's only a model to understand reality and thus helps us to get an overview and a framework to organize many facets of a theme. This framework for knowledge organization allows us an orientation which is important to be gained as a stable basis for a secure means of

existence and an evolutionary learning and doing ability in our times of **Dynaxity** (i.e., **Dynamic** and **Complexity**). In these times of paradigm change from the traditional world into an Inter-networking world wide society, **we cannot abandon to struggle for principal insights!**

This cognitive model from Popper can be combined with a dynamic approach from systems theory – the **cybernetic circuit** and becomes then a very powerful tool to categorize organizational processes, especially of Software Estimation, in our case.

3. Cybernetic Circuits

The important science of cybernetics, nowadays more likely called **systems theory**, was developed by Norbert Wiener in the forties of the last century, who described it as the art of the helmsman or pilot or, to be more precise: the science of regulation and communication in living systems and machines. It can be described as science of the behaviour of complex systems for which communication processes are essential. The model allows us to describe, understand and control the behaviour of complex systems. The advantage of this model is that it defines feedback loops and dynamic equilibrium for self regulating complex systems. This is achieved by the model of the **Cybernetic Circuit (CC)**, which consists of the following for parts (**instances**):

1. The governor (Regler)

Gets measurements from the measurement link, decides, provides the goal of the CC and delivers decisions and goal to the adjustment link. The Governor chooses the modes of activity in order to reach the nominal value or to keep it steady.

2. The adjustment Link (Stellglied)

Chooses the measures to be performed and delivers the adjustment factors for the mode of activity (chosen by the governor) to the regulating extension

3. The Regulating Extension (Regelstrecke)

Performs the measures chosen by the governor in accordance with the adjustment factors chosen by the adjustment link. The shorter the regulating extension is (e.g., the available time), the better can the basis of measures chosen which are necessary to control the system. Disturbances may influence the system (the CC) while the regulating extension is active.

4. The Measurement Link (Meßglied)

Measures the degree of goal fulfilment, checks for deviations from the optimum which may arise from disturbances and delivers this information to the governor.

Fig. 2: The model of a Cybernetic Circuit

The complete process is called a feedback loop and leads to a dynamic equilibrium called homeostasis: the system is self-regulating!

Examples for such CC's are manifold. The very simple models for the explanation of the principles are the central heating, or, to stick to the original meaning of the word cybernetics, the trip by boat in unsafe waters with a pilot on board. Project Management can as well be seen as a CC. Here are the four instances of every example at a glance in Fig. 3:

	Governor	Adjustment Link	Regulating Extension	Measurement Link
Central Heating	Temperature chosen on thermostat	Switch of the central heating	Radiator	Thermostat
Ship	Captain	Helmsman	Motor	Pilot
Project Management	Project Leader, Stakeholder, Steering Committee	Criteria for Project Success or Failure, Project Progress	Project Team, Project work, Problem Solving	Project Controlling, Quality Assurance

Fig. 3: Examples for Cybernetic Circuits

As we all know from our personal experience, the **central heating** is a self regulating system. The temperature chosen on the thermostat (governor) will be the steady temperature of the room, if the heating is not disturbed. The governor delivers the chosen temperature (goal) to the switch of the central heating (the adjustment factor) which delivers the temperature chosen to the Radiator (regulating extension) which is heating the room. The thermostat (measurement link) compares the temperature of the room with the temperature chosen on the thermostat (governor) and informs the governor about differences.

The example with the ship is analogous. The captain (governor) tells the helmsman which course he should steer. The helmsman (adjustment link) influences the speed and course of the ship (regulating extension). The Pilot (measurement link) compares the course with the secure path through the unsafe waters and informs the captain (governor) about deviations.

The Project Management example is as follows: The governor (see Fig. 3) sets the goals and delivers the decisions according to the informations of the adjustment link which delivers the estimation, planning and metrics of the project. The project team does the project work and problem solving (regulating extension). Project controlling and quality assurance report the deviations to the governor.

4. The Cybernetic Circuit of Software Estimation

Project estimation is an often forgotten task of project leaders. Nevertheless it's a most important project management task, because it's the basis for solid project planning. Project estimation can as well as project management be seen as a CC.

Governor (Regler)	Adjustment Link (Stellglied)	Regulating Extension (Regelstrecke)	Measurement Link (Meßglied)
The process of estimation	Methods for estimation, historical databases	Measurement, Monitoring and Tracking of Estimation	Controlling of Estimation

Fig. 4: The Cybernetic Circuit of Software Estimation

The process of estimation (governor) delivers an object to be estimated to the adjustment link, which uses methods for estimation and historical data. These methods and data are used for measurement, monitoring and tracking of estimation by the regulating extension. The measurement link does the controlling of the estimation and informs the governor about differences.

The following Fig. 5 shows the CC of software Estimation in a simulation tool developed by Dietmar Gausselmann according to ideas of the author.

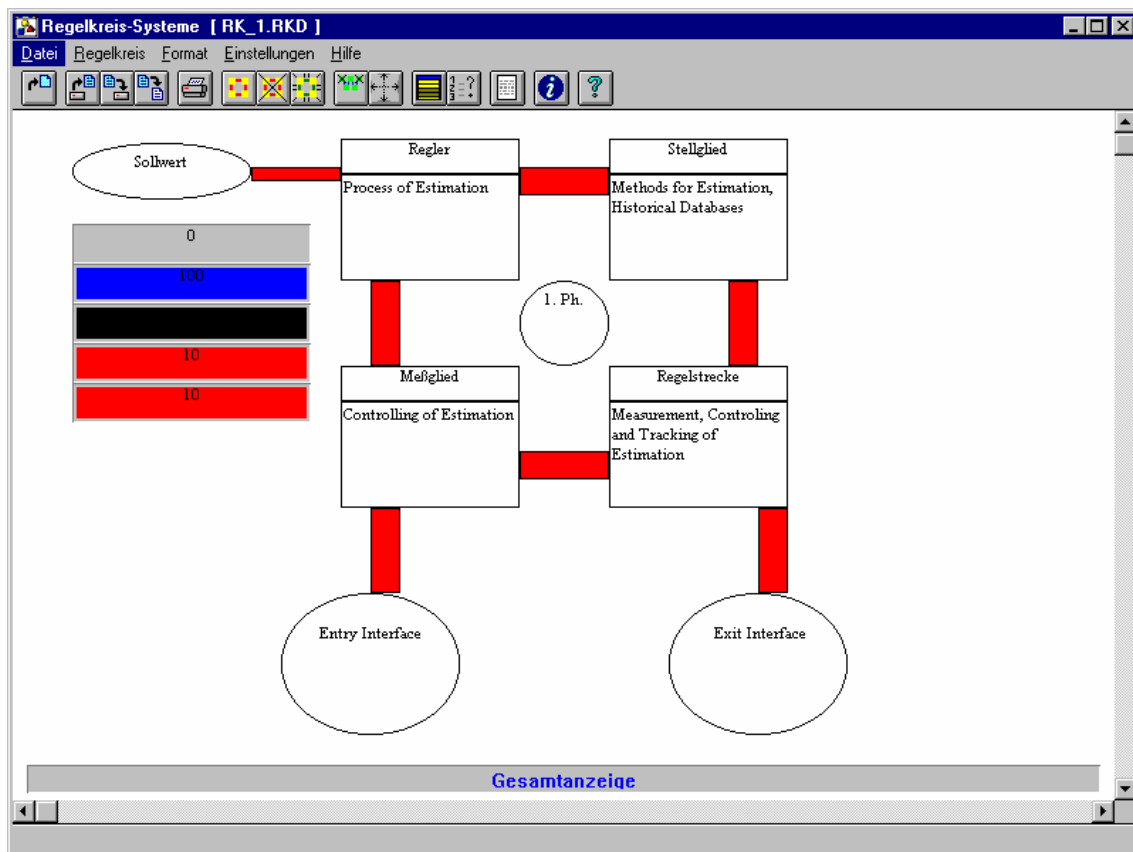


Fig. 5: Simulation of the Cybernetic Circuit of Software Estimation

The system works with a Delphi database and connects up to 20 CC's in linear combination. For each CC the actual value, the nominal value (goal), the maximum disturbance, the probability of disturbances and the maximum value of increase per circulation can be entered and statistical data of these values for each run of the CC can be stored in order to examine the behaviour of CC's.

5. The Application of the combined models to Software Estimation

The advantages of dynamic self regulating CC's can be combined with Popper's holistic three worlds view to form a holistic classification framework (HDCF) for software estimation which then delivers an overview of the aspects of project estimation for orientation (see following Fig.6).

HDCF	Governor (Regler)	Adjustment Link (Stellglied)	Regulating Extension (Regelstrecke)	Measurement Link (Meßglied)
World 1	Goals and objectives of estimation, information base of estimation	knowledge-base, estimation methods, object of estimation, documentation of estimation, tools for estimation, metrics organizations	continuous measurement and tracking of metrics, estimation convention	controlling of metrics
World 2	estimation problems, estimation culture	lack of historical data, precision of estimation	honesty of estimation, acceptance of estimation, estimation errors, people not willing to do estimation and/or documentation of estimation	controlling of estimation, requirements creep, early warning systems
World 3	software product and process metrics, milestones of estimation	introduction of estimation, requirements for estimation metrics, -methods and -tools	estimation standards, -rules, -principles	benchmarking

Fig. 6: Holistic Dynamic Classification Framework for Software Estimation (HDCF)

The HDCF shows the importance of the four instances of each of the three CC's. Whenever one of those instances doesn't function correctly the CC will be disturbed and must be influenced by extraordinary measures to succeed. We also see in this HDCF that Popper's three worlds show the hard facts (world 1) and soft facts (world 2) as well as the management- or political aspects of estimation which we observe in our daily work. All the 12 aspects of this HDCF must be observed very well if one intends to arrive at a self regulating estimation culture in an organization.

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