

A management approach for learning systems

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As is the case with natural sciences, developments in economic sciences repeatedly put the traditional order and criteria in question. Knowledge gained in chaos and catastrophe theory, complexity and artificial intelligence research, mathematics and logic, requires a transformation in what linearity, causality, stability and predictability mean to us.

The increased speed of capital circulation allows the differences between fixed and variable capital or between constant and circulating capital to become blurred. Reality is perverted by the international structural forms of value oriented accounting. Only a dynamic model could explain measures that change constantly through space and time.

So as not to lose oneself in a network of relativations, like many economists, the author treads the path of a constant and systematic observation of processes and consequently builds upon a theory of process systems.

The author would be pleased about a critical discussion of his thoughts or suggestions concerning this subject. The following article may be obtained in a complete version by mail under: Andreas.Fornefett@t-online.de

Introduction - "Not everyone who breaks the marching order is ahead of his time"

Doubtless, the formalised taking into account of time and dimensions of risk in the conceptual plans for financial planning, valuation and control of companies represents a major step of development, in the same way as the consideration of soft criteria. To superimpose these partially trend-oriented approaches onto a value-oriented base does, however, almost hinder the transparency required from participants in the market.

For a short period value-oriented control replaces optimisation of trends with the following target:
Maximise the market value of the capital invested.

On the highest aggregate rank, and assuming perfect markets, this target would in theory become compatible with the optimisation of the need oriented flow of market participants. There would, however, be no transparency.

Transparency is of fundamental importance to learning systems. But, strategic patterns even overlay naturally tactical behaviour of people. Thus, the ability of the competitors in the market to act according to plan does cause market analysts to give up vis-à-vis the apparent chaotic result of unrestrained reflexivity.

In circular processes cause and effect are melted together, and the future influences the past. For motion always requires potential and all pushed needs an inner space (elasticity) or an free outer space (density). For Europeans and Americans the Asian concept of time still sounds somewhat exotic. However, thinking in cycles or different dimensions and not exclusively in one dimensional linear time processes should become more familiar to us.

The model set out below forms a kind of synthesis of these ideas.

Optimisation of processes instead of maximisation of the status quo

During the past three years I have been advising the adoption of A. Rappaport's cash-flow model for insurers and banks too. During the saturation phases of important industries of these companies this definitely provided a helpful tool for their evaluation. In the case of industries at a different phase the results remained unsatisfactory.

That is why I decided to write about cash-flow valuation and control of conglomerates and had the idea of developing a dynamic model for this. My attempt to combine known approaches with an option model, to weight the input and to carry out further manipulations, did not produce a satisfactory result.

Each system probably needs its own explanatory model. A mathematician might formulate: $\mathbf{A}_T = \mathbf{B}_T \Rightarrow \mathbf{1} = \mathbf{A}_T / \mathbf{B}_T$, the physicist might prefer the formula: $\mathbf{A}_T = \mathbf{B}_T \Rightarrow -\mathbf{1} = \mathbf{A}_T / \mathbf{B}_T$, for combining equal conditions consumes energy. I followed up this energy idea and proceeded from rigid structures to processes: $\mathbf{A}_T = -\mathbf{B}_T \Leftrightarrow \mathbf{1} = \mathbf{A}_T / -\mathbf{B}_T$.

Further studies, which I was able to extend into the natural sciences with the help of my friend Dr. Helmut Scheuermann, finally led me to a system-oriented approach which describes every elementary system via the combination of its "potential", its "performance" and its "momentum/stimuli":

$$\mathbf{C}^S(\mathbf{T}, t_i, t_w) = \mathbf{A}(\mathbf{T}) / -\mathbf{B}(\mathbf{T}) * -\mathbf{b} / t_i * t_w / \mathbf{a} .$$

\mathbf{C}^S	= flow balance	$-\mathbf{b}$	= distribution flow, output
\mathbf{A}	= capacity, condition A	t_i	= linear time
$-\mathbf{B}$	= distribution, condition B	t_w	= cyclical time, input
\mathbf{T}	= standardised period of time	\mathbf{a}	= flow of capacity

In similarity to the theory of Bernoulli, meaning that profit grows in inverted proportion to the previous amount of assets, this is a system of measurement for something that cannot be counted. The value of the flow balance \mathbf{C}^S represents the development of energy of a system with the potential $\mathbf{A}(\mathbf{T}) / -\mathbf{B}(\mathbf{T})$, the performance $-\mathbf{b}/t_i$ and the momentum/stimuli t_w/\mathbf{a} in the period \mathbf{T} .

Energy represents the lowest common unity of all economic activity. It is a means of barter as well as of communication. The above system formula is based on the flow equations of two processes, that lead to the result of +1 when their factors are balanced, or show a surplus of (>1) or a requirement for energy ($0 < \mathbf{C}^S < 1$) when they are not balanced:

$$\text{flow balance}_{\text{disintegration}} = \text{demand} / \text{supply} * \text{production} / \text{time}_i * \text{time}_w / \text{consumption}$$

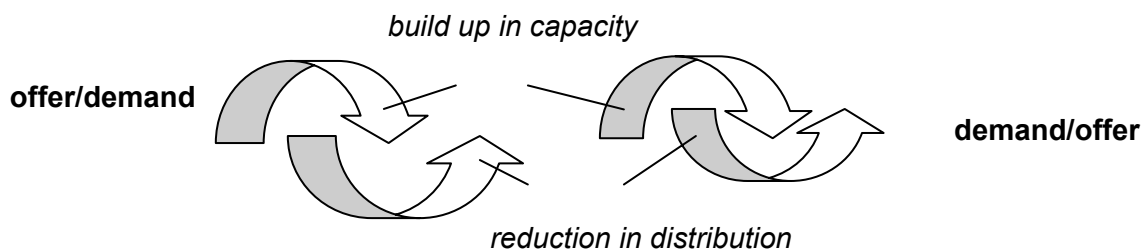
$$\text{flow balance}_{\text{growth}} = \text{supply} / \text{demand} * \text{consumption} / \text{time}_i * \text{time}_w / \text{production}$$

Living elementary (open) systems are composed of processes of disintegration and growth. The process of disintegration releases energy needed by the process of growth. In a closed system the flow balance of disintegration would be equal to that of growth. The total energy of the closed system would be retained. Mankind and its societies are, however, open systems.

Their development is shaped by wild cycles consisting of innovation, subsequent increase, scarcity of resources, and migration. Therefore wavering demand and/or offer capacities were and still are the reasons for differing processes of growth or decline. In a closed system, on the other hand, the impulses based on amount and time would have stayed constant.

The economic systems of all living creatures evolve on the basis of an increasing division of labour and/or the division into offer and demand. At the beginning there is a build up of capacity because of an internal or external lack of balance, for example, a catastrophe. A reduction in distribution means the end of the start process. Disintegration (evolution) or growth (reproduction) follow on alternatively.

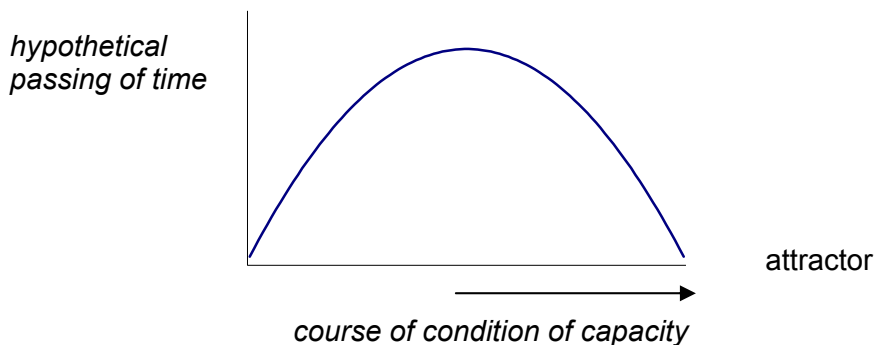
Systems can only be represented consequently by means of an integration of different processes, processes, on the other hand, as a combination of procedures. Each process consists of two procedures: the build up of capacity $A(T) * t_w/a$ and the reduction in distribution $1/-B(T) * -b/t_1$ and the build up of capacity $B(T) * t_w/b$ and the reduction in distribution $1/-A(T) * -a/t_1$ respectively:



With $A(T) * t_w/a$ a process of system input is described mathematically. The output process is represented by $1/-B(T) = -b/t_1$. It is derived from $-B(T) = t_1/-b$:

$$A(T) * t_w / a = -B(T) * t_1 / -b \iff 1 = A(T) / -B(T) * -b / t_1 * t_w / a .$$

With the transfer of one condition to another, time ends and then starts again afresh. This new definition of time follows from the transformation of the above formula for the flow of a procedure (for example build up in capacity) to: time = condition (capacity) * flow (flow of capacity). Shown graphically, the irregular course of time describes the life cycle of the procedure:



Characteristic for each flow are its attractors, the final conditions of a dynamic system during the course of a process (such as a balancing process, the transformation of a phase). They form the field of current through their force of attraction. The natural sciences differentiate between various attractors.

In the case of point attractors the system aims at a stable condition during the course of time. In the case of border cycles the system will level out into a stable cycle. By the superposition of two border cycles a torus shaped attractor will develop. A superposition of positive and negative procedures will in the end lead to an incarnation of processes and systems.

For Rem Koolhaas the process of moulding is, for example, of a rather morphogenetic nature: "morphogenesis as approximation to a form as being in a fluid instead of a rigid condition, form as a temporarily stable configuration in the process of entropy." He regards reality as an unstable superposition of flows instead of as a collection of objects, amounts or mounds that do not last forever. On the other hand there is a saying: "All the wisdom of the universe shall be yours if you recognise that emptiness is fullness and fullness is emptiness."

In the observation of a flow there is no zero amount. Matter or "static" systems only exist in relationship to other systems and appear as such during fictitious periods of time T - at most for the duration of their lifetime. This is why matter perceived by us with our senses is nothing more than concentrated energy. This flow factor is what should be optimised altogether.

Living systems may only be experienced over a period of time

How we are connected via the biosphere is possibly shown by a statistical phenomenon that was recently discovered by natural scientists: The deformation of the normal distribution curve of natural phenomena. The symmetrical properties of different procedures in nature are being lost; initial frequent occurrences increase through learning, the curve is shortened, as in life cycles. Empirical investigations as to the diffusion of innovations have in many cases proved a normal distributed or curve similar to life cycle. As a descriptive model the product life cycle therefore has a high expressive value *ex post*. As a prognosis model the model would only then have a normative expressive strength, if it represented independent values. Is that so?

For the period of existence of products and goods the product or branch life cycle shows a similar cycle of creation and demise as in the case of biological organisms. The theoretical base of the s-shaped curve-line is not, it should be said, derived from biological theory, whose application to social science has been appeared to be problematical.

As the product life cycle can be influenced by the strategic competence of the company the product life cycle concept as such is only suitable with reservation for prognosis purposes. Furthermore, constructions such as family, society, country, culture are fictional institutions, whose dissolution is not a matter of course.

If the fact that no link may exist between events is a necessary condition for the normal distribution, one may assume that data which are distributed in accordance with a Gauss bell-curve, are arrived at on the basis of observations which are independent of one another. Why are we disappointed by the prognoses if the interpolation then represents a good convergence?

First of all, trends develop so slowly that shocks can occur and disturb them. Furthermore, a regression may arise that is so marked that events will not stabilise - i.e. vary as much as by a point. In fact this value can itself be unstable and can change over a period of time. A model to be used for prognoses must therefore take options into account.

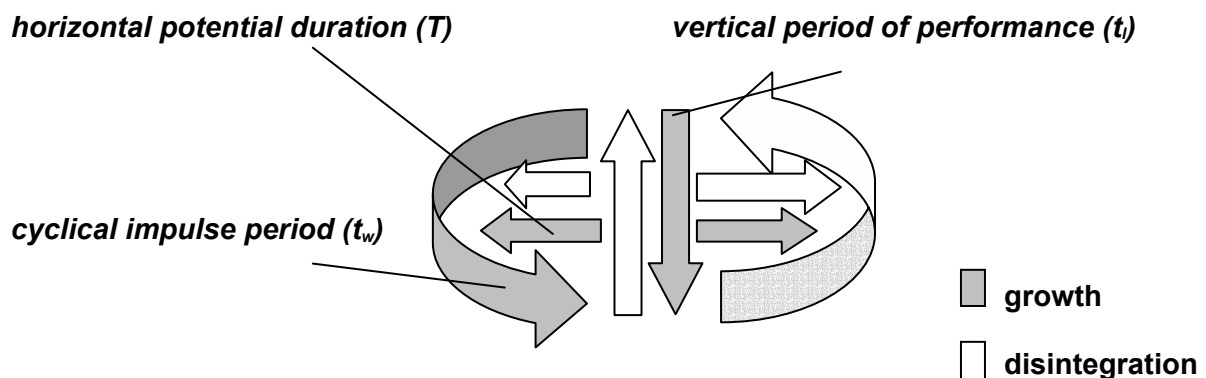
The failure of long-term forecasts in the economy or elsewhere often comes to light when plans are made for a time period over that usually applied to the system concerned; as soon, in fact, as interaction with the environment plays a greater part than own mechanisms of the system concerned. The evaluation of a complex structure is therefore always made "top down".

In doing so flows or processes may on no account be combined on a lower level. They should be organised "bottom up" at as high a level as possible. In industry (risk-)strategies are developed in this direction: process simulation, TQM, batching or delay strategies. Common to all strategies is the aim of the optimisation of processes of one or more systems.

As, depending on its starting position, the changes within a process may occur differently and in different directions at different speed, old knowledge must be kept in mind. Three spatial dimensions are set against three time-based dimensions. In this way each particular "location" of the system can be described at any time.

The ancient Egyptians already knew several kinds of time. The observable, earthly time with beginning and end, as well as the "Nechech" and the "Djet" eternities. Both refer to the time outside ephemerality. Though, in fact, Nechech expresses an endless number of cycles, both passing (hours) as well as rejuvenating (years). They facilitate change.

Djet, however, describes linear permanency: "what is there forever". If these two concepts are shown graphically Nechech corresponds to an endless circulation and Djet to an endless straight line. Earthly time describes the tension of the poles that build themselves up and demolish themselves and finally turn - a metamorphosis of disintegration and growth:



Possibilities of evaluation of variable systems

The "value" of a system results, in effect, from the actual location of its processes. However, even on the basis of spatial configuration, variable systems hardly allow for a prior description of the system's possible positions and its parts respectively. For this reason an experimental series should be set up to determine the frequency of possible positions.

Some time ago scientific disciplines concerned with the study of living matter started to develop methods of describing vague forms. The human body, for example, hides its interior. Its form is dependent on the currents and movements of life's procedures changing from time to time.

Stereometry attempts to describe the human organs in a way, which is indirect, fast, flexible and versatile. It is based on ideas and methods derived from geometrical probabilities. It is able to describe

the flowing property of dynamic bodies despite the fact that these tend to be geometrically unstable and deformed.

The necessity to interpret a reality consisting of flows and changing phases requires a method that is able to handle deformations, distortions and variations. The re-thinking of the turbulent, stochastic, differential models of today's processes of production is an indication of the change from paradigms to syntagmas.

Inexact geometric calculations are able to measure indefinable, mobile and flexible behaviour without casting the corresponding effects into reduced fixed forms, and they thereby represent an open form of geometrical description. The probability geometry of the biometrical method of random cuts represents *one* possibility for flexible measurement.

The random cut opens the possibility, to describe geometrical uncertainties within a precise and rigorous measurement system and to use it for design too. The method is based on a system of a series of cross-sections in combination with the corresponding coefficient of size, form and orientation.

For further reading I would first of all recommend F. Bookstein. His work contains a detailed description of the various forms of inexact and diffeomorph geometry and their application to organic matter. The possibilities of measurement using linear or non-linear algebra will be explained at a different place.

Even in physics one does not use the individual positions of atoms for the evaluation of a mechanical process but falls back on statistical values such as mass and volume, on average values such as density or temperature that do not exist in the case of particles but are the result of their coexistence.

Despite all the available statistical details and data gathering, today's economic theory too works only with very imprecise, if not falsified images of reality. The system's approach, however, refers to interactions not individual elements. It changes groups of variables at the same time and not only just one at a time, e.g. the gross national product - as is often the case.

On this basis a prediction of the behaviour of the system, using the model described above, would be principally oriented on the observation or non-observation of the laws and categories of the natural sciences. The way of thinking in open systems will have to be applied to the methods of work in respect of the model and at each stage allow for corrections and learning processes on the part of the user.

The conditions of a flow balance are only one aspect in the evaluation of a system's survival chances and ability for development. It should always be analysed starting with the whole and working towards the detail, and its processes should be followed from their conception. That which has been observed should be allocated to certain procedures and factors. The tendency to an extrapolated way of observation will automatically become obsolete.

The control of dynamic systems

The control of the system is carried out by way of the same model, this time with the framework factor $\mathbf{A(T)}/\mathbf{B(T)}$, the regulating factor $-\mathbf{b/t}$, and the control factor $\mathbf{t_w/a}$. The input per se is controlled by time. The output is controlled accordingly or via dispersed flow. Thus, the ratio of the conditions should be chosen so that their two periods in \mathbf{T} correspond.

The answer to the question when to invest and/or when to save is therefore not only dependent on the phase of life of an existing system or project. It is rather an interplay of the life cycles of the

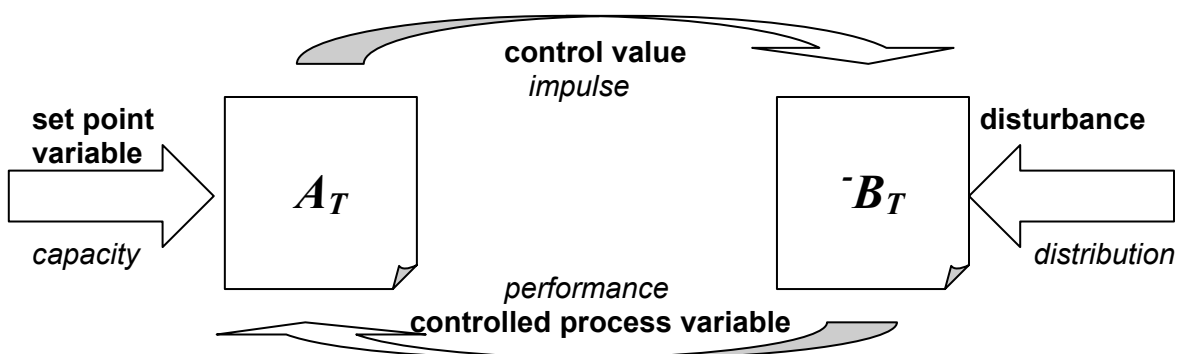
components of the potential, in this case offer and demand in the markets in which the processes of "performance" and "counter-performance" face each other.

Currents are forms of movement whose form can only be influenced indirectly. Interference with those currents produces unexpected forms which are often chaotic, sometimes however surprisingly regular. If a system encounters a branching it may develop in different directions. However, it is rarely foreseeable how a system will react at such a point of embranchment. In the catastrophe theory discontinuous changes of systems are described. Because of changes in the energy level systems may reach a critical point at which they mutate into a completely new condition.

On the basis of the evaluation the regulation of a system for the preservation or use of its energy may be carried out autonomously or in a controlled way via its control mechanisms or by the creation of an appropriate environment. The systems theory provides the economy with, to some extent, already widely developed methods - see in particular F. Malik and F. Vester.

The simplest example for an autonomous system is the control circuit. It signifies "life" in the sense of a stabilisation of the procedures in a system whose "spirit" can be found in the specific form of the combination of its processes during the course of time(s).

Control circuits are frequently found in biology and in technology. It is a system maintaining a flow balance in the face of disturbances. The value of the controlled process variable flows with time, is upset by the disturbance and is brought back to it by the activity of the control value. A simplified control circuit with the terms of the formulas used above is sketched below:



Each control circuit is primarily a circuit of information that is closed within itself. In a narrower sense it consists of the value that needs to be controlled and of the controller. This controller measures the status of the controlled process variable by means of a sensor. If this state is changed by the disturbance variable the controller sends an appropriate instruction, the so-called control value.

A final control element receives the instruction and deals with the disturbance through an appropriate control variable by the addition or subtraction of a corresponding exchange value. In this way the control system is fed back with itself. However, via the disturbance variable and the exchange value an open one may be connected to the outside world.

If the sensor reads a value that is too high, this will be reduced by way of the control element; if the value is too low it will be raised. Such self-regulation is known as negative feedback. Positive feedback would cause an upswing in the set point and destroy the system. Metamorphoses or other processes of evolution do, however, temporarily require such positive feedback.

The controller is guided by a lead value, which supplies it with a set point. This set point can, for its part, be variable, inasmuch as it itself is the controlled process variable of another control circuit. This controlled process variable can, in turn, be the control value of a third control circuit and this altogether can be the disturbance variable of yet another, and so on.

Normally a stable system regulates itself through negative feedback before it reaches thresholds capable of destroying the system. However, this does not apply if the disturbance variables move outside a permitted disturbance range. Control circuits can also be destroyed by interference with the internal regular proceedings of individual or interlocked systems.

A simple control circuit rarely meets practical requirements. It can only react in one way to deviations of the desired set point. Extended control circuits, which can react differently to deviations of the desired set point, have, for example a simple cascade regulator, a switch with which different variables can be switched on one after the other to secure a balance.

The activation of each of the next control circuit can happen in various ways in a cascade regulator, for example through a simple switching or through a random switching, in itself linked with learning processes. After all, a further level of evolution is reached by open regulation. The control value becomes the reaction that influences the environment.

Human beings have all these control systems available to them and consist of sub-systems communicating with each other, but also with the outside world. In the case of changing environments it does not make sense if a system acts only according to given behavioural programs. It is essential that it has the possibility of re-programming itself - a process usually described as "learning" - on this subject see D. Dörner.

As people create their environment, it becomes different. The desire for signs of legitimisation creates social cohesion. Cognitive ability enhanced by language then creates morals. Explicit rules and norms evolve. Thinking by way of self-questioning of the "ego" leads to a self-image and the ability to change.

From a higher regulating system to society

There is probably no viable system without functioning negative feedback. However, viable systems are inevitably open systems. In the case of open systems and as an explanation of the linkage processes respectively, the original formula should be extended by annexes, in this case 1 for system 1 and 2 (system 2). A linkage from the perspective of system 1 would have to be formulated as follows:

$$C_1^S(T, t_1, t_w) = A(T)_1 / -B(T)_2 * -b_2 / t_{1,2} * t_w / a_1 \text{ and}$$

$$C_1^S(T, t_1, t_w) = B(T)_1 / -A(T)_2 * -a_2 / t_{1,2} * t_w / b_1 \text{ respectively.}$$

C^{S1}	= flow balance system 1	$-b_2$	= dispersed flow, output, system 2
A_1	= capacity system 1	$t_{1,2}$	= linear time system 2
$-B_2$	= distribution system 2	t_w	= cyclical time, input, system 1
T	= standard period of time	a_1	= flow of capacity system 1

Presumably, there are in real life no isolated, closed control circuits, but open systems of several connected control circuits, always maintaining an interrelation only with each other, whose set points depend on each other. For us human beings the most complicated superior system of processes on our earth probably is the biosphere.

The interrelation of the activities of our human society is minimal in comparison to the interrelation of the processes of living creatures in this ecological system. Symbioses in the economy demand a stronger interest in communication between industries too and not just within them. Only when an exchange of information has taken place, an exchange of matter can develop by itself.

The trend to segmentation in the economy, in connection with a disenchantment with synergy, has shown that portfolio management is the essential task of company strategy. However, the concept of synergy failed because companies were not able to recognise synergies or to implement them, not because it is a faulty concept.

If a subsystem has an operative (material) and a financial (communicative) component, which cannot be treated as being separate from one another, the superior system consists in principal of a multiplicity of possible combinations or linkages of such functions by means of quite differing processes. Because of this a linkage strategy is always required.

The pursuit of a linkage strategy is based primarily on competition aspects, not on financial considerations: **portfolio_{competition} = attractiveness ° flexibility ° trend.**

It was the justification of a concentration on portfolio management that served the strategies constructed on the above: **portfolio_{finances} = weighting ° correlation ° volatility.**

The linkage of similar systems does not always correspond with a stronger synchronising of their flow. The combination of dissimilar systems does not mean the same thing as dissimilar courses. Similarly, pure portfolio planning methods miss their target in the same way as those initiatives that are exclusively oriented to competition. Related diversification could be associated with a horizontal strategy.

An increase in risk, resulting from a specialisation, is confronted by, for example, the opportunity of substantial better knowledge about the system "company" and its relevant markets. This link may lead to rising income with decreasing all-round risk, if the income trends of an alternative outside diversification only insufficiently correlate negatively.

It is clear from our observation of the system that, in a networked environment, there can be no simple standard solutions as they are often offered for the purpose of advertising. This is an illusion. For in reality we are dealing exclusively with complex problems, and these require complex solutions.

Up to now economic prognosis or explanatory models have represented a path, only partially system-oriented, of comprehending and analysing procedures or changes in condition. Their purpose is the maximisation of success. The assistance for making decisions on future action requires, however, an evaluation with a view to an optimisation target, the preservation of a system's viability.

In reality, no procedure exists for itself alone - it is linked with other procedures. The analytical impulse concentrates itself on individual elements of the system; this is why the sciences of today regard procedures as being isolated linear subsystems. But thinking in linear processes and its rules should, as described above, be linked to circular processes.

Conclusions

What we see, hear, taste, feel and smell is merely our personal perception and interpretation of reality. Our environment does not allow itself to be perceived or understood that easily, it is an abstract. The regularities of material or non-material processes are the same. The above formulas therefore apply equally to natural, artificial or mixed processes.

Inert mass, length and time are basic units of measurement for procedures. Tension, flow and impulse are such units of measurement for processes, as is energy for systems. All that we measure may as a rule be traced back to these. The argument between particle physicists and supporters of the relativity theories is pointless, as both opinions do find themselves proved right in due course (frequencies).

The use of physical laws and constants should yet produce many new ideas by integration into the above flow balances. I would still like to deal with some of them in my book and deal in further detail with some already raised. If the rendering of accounts were to be carried out in a process-oriented way, understanding and transparency could overtake any reflexivity still present.

Transparency requires little more than freedom from taboos. The often incompatible "cable spaghetti" intertwined with one another, which we have created since our socialisation, encourage asymmetry and lead to dysfunction. A wholly unlinked system would be unstable, but the number of networks is not so important as the way in which they are set up.

With growing interrelation the stability initially increases, until it starts to reduce again when a certain degree of interrelation has been reached. If substructures form the system stays viable even when there is a high degree of interrelation. Diversity is required for optimal interaction. The supporters of value orientation raise obstacles: the immediate comparison of income trends is too complicated.

The separation of the financial economy from the product economy should cause us to pay attention. Whereas the process optimisation in the product economy provides a long recognised example for the management of production and distribution systems, the finance economy is still committed to maximisation as its primary aim, but not to the benefit of the market economy.

In principle, a stable system regulates itself via negative feedback, before it reaches system destroying thresholds. This applies as long as the disturbance variables move within a system-specific range. The regulatory system is not burdened more heavily as a whole, but only a part of it, for example, a measurement function, which therefore fails. The system collapses.

If a person's temperature rises by three degrees to 40 degrees Celcius this is a sign that the person has a temperature and is sick. If the temperature rises by *only* three further degrees, the person would, however, not be twice as sick - as economic scientists would perhaps extrapolate - but would already be dead, as F. Vester puts it provocatively in his book "Neuland des Denkens".

The author is managing partner of PEER GmbH. Following a period of studying Law (Jurisprudence) and Economics at Georg-August-University Göttingen in the 1980s, he initially was a management consultant, later becoming a company manager of a middle-class corporate. In the mid 1990s he developed a cash flow model for financial analysis for insurance companies and, with PEER GmbH, commenced independent consultancy for corporate customers. Among his customers were companies like Citibank, Fidelity, Capital, Amvescap, Alliance Capital, JP Morgan, Lazard, Morgan Grenfell, Credit Suisse First Boston, UBS, Scottish Widows, Standard Life and Odey Asset Management.

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Each publication with further bibliography.