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SYSTEMS EVOLVEMENT FOR SOCIETAL EVOLUTION
THE ICT CASE FOR TRANSDISCIPLINARITY

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Abstract

The challenge to science comes threefold: Global change is paralleled by an ubiquitous driving impact of information, demanding a reconciliation of basic models to understand our world. Threefold will be the topic of the paper: to reconsider science in a transitional society forced by Information/Communication Technology (ICT) to rejuvenate societal structures. One key to a tentative answer lies in ICT as a driving factor. A closer look reveals a more profound quest. We need reconsider the contemporary paradigms of science as a means of survival and development. In a transitional society as ours science must oriented to the pragmatic solution of practical problems, by basic as well as applied research. It needs be multi-aspectual, as to meet rising complexity of the driving forces as e.g. around. ICT. As to cope with uncertainty, it has to search for a better grasp of risks, chances and potentials for future evolvement. Science has to specialize on single factors *and* to gain the overview on what ought and might happen, and how the chain societal development can holistically be controlled. Transdisciplinarity and basic scientific models reconsidered are demanded to carry transdisciplinary research. Systems sciences will qualify as point of departure, leading to an open five model proposition: Systems, Evolution, Complexity, Semiodynamics and Noo-sphere.
Key words: Societal evolution, systems, ICT, transdisciplinarity

Prologue: Quest for Transdisciplinary Open Science in an Open Society.

Scientists are supposed to think rational, transparent and to argue retraceable. They are bound to make the differences which make a difference and to make balanced judgments. When necessarily specializing, overview never must be lost over the issue pursued and the entire system eventually affected. Science is not to fall for ideologies, if right or left, or religious or quasi religious, and by no means to fundamentalism, corporatism or any other 'isms'. It needs continuously self-critically doubt and double-check oneself as the never neutral observer. The nucleus for science is to be rational, critical and *open*.

Science represents a way to see one's world and oneself in it as to co-act with it. Science cannot be free of values, as Max Weber considered. Survival and sustainable development, for example, are basic values. As to remain an open dialogue science is compelled to avoid ultimate 'truth'. Any science with a idiosyncratic surname bears the suspicion to carry a non-scientific claim.

In K. Popper wrote 'The Free Society and its Enemies' [1.], F.A. v. Hayeck 'The Road to Serfdom' [2.; 3.]; and C. West Churchman 'The Systems Approach and its Enemies' [4.; 5]. These admonishments have bee followed by others. There are too many movements abandoning ratio and science as a means to meet the dangers pressing and the tasks to be accomplished: religious fundamentalists, right and in particular left wing political groupings around ideologies, and not least illusionists from green and like movements. Resulting political and economical disasters remind: if rational judgment is lost, reason and the future are lost, too. In particular science as the nucleus of mental culture needs be open as to remain an effective mode of learning; of opening potentials and thus inducing change of controlling change.

Learning in science must never cease to alter and improving its own base. Models, methods, procedures, agreements on proof for example are subject of learning and change themselves. As a mode to see and to cope with the world, actual science is to be understood a historical and cultural phenomenon according to development and developmental phases. Actual science is obliged to develop incessantly the new models sufficient for the prevailing historical/cultural state and its challenges. In particular in the most sensitive transitional phase of change the actual models need be questioned as temporary, representing but specific versions of more basic models. Such basic models carry crucial qualities to cope with a changing 'reality' from different points of view without loosing the actual task, the context and the overview to gain sustainable solutions. They will permit to explore potential, probable states in the future of the society. In parallel they will make possible *transdisciplinary,* requisite holistic attempts to solve complex practice issues. They will support learning not constrained by obsolete states of science nor disciplinary boarders. Both qualities – and others derived there from- are crucial for evolutional learning. *Open learning* only on a transdisciplinary base will serve an open science relying on *and* reconstituting an open society, capable to rejuvenate itself.

1. TRANSDISCIPLINARITY: A CHALLENGE TO SYSTEMS THINKING

From its origins science develops both by retaining its unity via (re-)unification and by diversification when diversifying to the indigenous specifity of particular topics. The quest for transdisciplinarity but reflects the dynamics of scientific evolution. A fresh look to the beginnings of science in topology and astrology corroborates the view. The review also points to the, in modern terms, 'systems and systemic' nature of base scientific thinking and systems thinking. In Mesopotamia the cosmic system was perceived analogue the geologic systems enabling a system of targeted human reaction to the cosmic forces following systemics of human behavior. Behind lies the believe, the hypothesis and the rational as well as the emotional urge to a unity of science, analogue to a unity of man and the unity of the world as man sees himself in his world. The 'hard' and the 'soft' systems approach and the systems movements following find their places here. As examples may be named cybernetics I to VI…(so far to my knowledge) do, or the General Systems Theory of Bertalanffy [6]. The latter contains remarkably the necessary diversification of aspects as well as their re-unification in a systemic-holistic understanding of man in his world.

Transdisciplinarity, first, points back to the unity of the systemic origin of science in cosmos, the world, and human nature. The back to the unique basics of science implies in particular the ways man perceives his world by sensory information and deals with it by *information processing, evaluation, validation, decision and control* of resulting action. The image of the world to cope with consists of received, processed and 'learned' information taking the shape of knowledge and knowing. Again knowledge and knowing constitute as systems, necessarily depicting the inner and outer environment as systems, sufficiently reflecting the qualities for survival and development. Knowledge covers the whole range of what can be – actually – already attempted by the available means of research. Research is subsumed under the strict rules of science, cogent from formal to natural sciences to life sciences and – with certain restrictions and modifications – to the humanities. For what so far remains outside the 'exact' sciences as e.g. the 'qualia' of human experience Galilei's dictum stays valid: to make measurable what not yet can be measured.

Transdisciplinarity, *second*, on this shared base, follows the need to re-integrate the discoveries of specialized scientific disciplines under the auspices of pragmatics. Science is a means to deal with the risks and chances of the environment to co-live and co-evolve with. Attempting to integrate disciplinary knowledge as to resolve practice problems again the model of systems thinking is followed. That is but due to the systems and systemic quality of the basic models and the systemic construction of the 'world' thus presupposed. It is in particular the systemic faculty of the entire process of '*knowledging' and 'knowing'* including the role of 'languaging', of priorities in evaluation etc., which underlines the role of *information and control* as in every (re-)action so in science. Not by chance together with the rise of the systems concept also general systems theory (which emerged essentially from biologic thinking) and higher cybernetics developed.

The systemics of information and knowledging inherent in the systems approach deserve a distinct acknowledgement. As to understand the focus, the range of information and communication needs be taken rather wide. On the most fundamental and abstract side research in mathematics and non-linear mathematics, the pre- sciences (as pre-logic) and in general the theory of science(s) need be comprehended. Beneath the formal approaches, as examples for the life sciences, biology, physiology and in some aspects psychology contribute. In particular the emergence of consciousness, language and the higher consciousness of the human mind relate to a more thorough understanding why and how life systems deal with information and communication. Such research supports the exploration of, as it is subsumed under ICT, Information/Communication Technology carried out in the anthropologies and humanities. The salient questions extend to the role ICT plays as a cause, a driver, a consequence and a symptom in the development of society in general and in the actual phase of societal transition in particular. How and how far will ICT change human learning, human togetherness? In which way will communication (N.Luhmann [7]) provide the glue which hold together societies? Will it help to dissolve the tensions which drive them apart? How to understand the role in the global change process as a cause and as a means to cope with societal phase transitions? How, as a means of policy, does ICT affect constitutions written and ‘real’? How far does it affect values and value systems, views of the world (Weltanschauungen) and thus fundamental human behavior individually and in society?

As in a concave mirror, the aforementioned topics concentrate in the quest for transdisciplinarity. They necessarily be addressed when dealing with paradigm change, with basic science, with models to be reconciled and with developments to be anticipated. Systems thinking not only in the fundamental sense as above be fundamental. It will be so specifically when applied to concrete issues, when actual tasks will play a crucial role. The process has already begun (see the systems branches in disciplines) but will disseminate both specifying and serving the transdisciplinary shared base.
A new role for the systems approach, then? Less an essentially new role; systems thinking has been always material at the base of science. Rather the branching application is to be furthered of systems thinking to disciplinary sciences; and a strengthening of research into the fundaments of the systems approach itself, the *principia*. The first will support practice problem solving and the practice base of transdisciplinarity. The second may shed new light to fundamental models and the (pre-)axioms behind concerning systems as well as science and human learning and knowledge in general. Not least systems as a discipline by itself may contribute to meet the challenges imposed on our world by scientific transdisciplinary stimuli to perceive, acknowledge and transfer new potentials.

2. A SOCIETAL BASE TO PRACTICE ORIENTED TRANSDISCIPLINARITY

Transdisciplinarity, in short, means reconsidering basic models on the axiom level of science as to re-establish the carrying base for practice oriented integration. The driving causes behind appear many-leveled and manifold. Scientific development is, after a long phase of often extensive specialization, ripe for integrative endeavors. Adding to internal pressures are demands from practice. Ever more complex problems within a likewise complex and dynamic environment require the contribution of assorted disciplines and their integration into an operational solution. *Inter*disciplinary co-operation will not be sufficient if at all possible: the shared base models, the shared evaluation modes and not least shared semiotics are missing. Disciplinary openness of solutions to future developments becomes condition sine qua non: in a rapidly changing environment any solution owns but a temporary value if not designed to be changed systematically with a changing problem environment. Which means that any problem, as its solution, are understood as the actual temporary case of a more general case. Operation plans are safe for future developments only if and so far they are designed as a specified actual class of general super positioned classes. Advice, for example, to guide an actual phase of societal development needs have a model of society and its development in general. It needs positioning the actual phase within a sequence of phases to occur possibly in the future, employing a tentatively universal model of societal development. In times of change and uncertainty general knowledge supporting a strategy is presupposed. As is a methodical and operational base to *learn* the qualities of the actual position and to explore chances for its future options and actions. To this end, also, an idea of the general course of the development (as e.g. evolution) is requested.

In the realms of the society – government, institutions, just people - the faculties and capacities of science gain a new importance to help resolve societal issues. As science extracts scarce societal resources it is itself by society valued as such. Though well known from previous times – see e.g. Feyerabend [8] and later the Critical Systems approach – the discussion on them social responsibility and accountability of science adopted a new quality. A first triangular relation is hypothesized between Technology, Society and Economy/Business. Technology has to serve society with minimum side effects and optimum efficiency. In return society has to secure a frame wherein science and science originated technology can emerge. Society also has to provide free space as well as society protecting regulations for Economy and Business. In return economy/business are responsible for the economic transfer of technology and for the economic base for societal development. The interests between the three players need be *balanced* in favor of society, one of the crucial points the support of *creativity, ideas and innovation*. A closely related triangle investigates the desirable check and balance between Science, Democracy and Economy. Democracy needs secure the guided freedom necessary for a prolific science and a thriving economy in the service of society. Science and Economy are obliged to support the mental and material resources. The role of democracy needs active, developmental, securing a free and open society. In the negative: neither ideologies nor however well meaning incompetence, neither bureaucracy nor corporatism must be allowed to destroy the potential for adaptive change and active evolvement. With the support of a healthy constitution only, science and economy society will be able to change profitably – or it will be changed for the worse and an aggravating spiral down. As it can be observed right now in the European Union and their participants.

In this context of the many impacts ICT exerts on societal evolution, one factor can be singled out. ICT ought fight even more than it already does for the *appropriate information of the people whose votes carry or loose democracy*. Voting for ideologists and 'well meaning people' instead for competence and leadership rests also on missing information if not on targeted political disinformation. Only people who are aware that globalization as similar developments cannot be stopped nor ignored but must be met by active change will vote for reforms and reformers and resist deception. (No 'stop the world, I want to get out') Otherwise first the wool is pulled over their eyes and than the skin over their ears, common political practice. Reforms need be 'sold' to the stakeholders so that they will participate to carry them out. ICT faces the often extremely difficult task to transfer highly complex topics to the broad public without distortion or obvious reduction. Then issue to represent transdisciplinary complex contents in an understandable mode shows still many white spots on the ICT map; as does the tasks to teach the audience to understand and gain insight.

3. GROUNDING MODELS DESIGN FOR TRANSDISCIPLINARITY

As a societal phenomenon, science is an expression of self-understanding and world-view, a representation of the 'Zeitgeist'. Throughout history an intricate interplay can be observed between the societal atmosphere, its basic beliefs and convictions, and political movements, power plays local and global. Preceded by scholastics, the religious orientation to afterlife during Renaissance developed via astrology and alchemies to modern science based on rigid rules of logic and rationality. Colonialism appears as one symptom of a new orientation to explore and exploit the existing life world; naturally implying power play for repositioning in the networks of power. In parallel the models basic for science developed into new forms. In the 21th century, after a hiatus of some sixty years after WWI and WWII, the world faces a new fundamental transition. During the last five years the full impact of globalization and its far reaching, comprehensive consequences have become obvious. The sources of the upsurge in transitional change are manifold. They can if but roughly be ascribed to science transferred into technology and the essentially free exchange of both technology and its scientific foundations globally. ICT in particular paved the path to a globalization of technical know how and scientific research.

ICT as a technological means or driving force, and the global transition also in reverse affect science fundamentally. Of course there is no mono- or oligo-causality; often ICT and globalization but supported, forced and enabled scientific developments latently pre-existing. As the old pun goes: science BC and science AC (before and after Computer assisted globalization) were changed by ICT not only in their operational capacities and modes. Even more important, science is compelled to continuously alter its base models.

A but rough and superficial outline signifies, as a fundament for a system of basic models, the assumptions of Formal Sciences. They include more recently what may be called pre-sciences, as pre-geometry, pre-logic etc. They explore what usually is addressed as the 'fundamental relationships' behind the 'laws' e.g, of physics: namely symmetry and symmetry breaks, dimension theories etc. Logic and order theory also explore pre-states; in logic the predominance of formal logics (Frege) recently being questioned in favor of the predominating syllogism. Mathematics grew into non-linear mathematics; the mathematical semiotics changing from a the base of 'number' to that of 'group'. Part of cybernetics also may be counted to the formal sciences; Cybernetics II, III …opening an inroad to understand likewise pre-scientific fundamental attempts to e.g. neurology or psychology. More obvious appears the influence of cybernetics (and systems) on nearly all levels and aspects of ICT.
As preceded by cybernetics, on the next level the sequence of basic models acquire to their formal qualities those of content. 'Embodiment' gradually proceeds from physics to physiology to language and characteristics of the human mind (Edelman [9]. The developmental sequence comes arbitrarily and may change under changed auspices. As presented here it is *both hierarchic and networked*; there is mutual overlapping. Each model inheres the foregoing ones as a base. It describes also the qualities essential for the next level in the 'evolution' of 'real' systems. It is focal, but presumably non-conclusive and open for other basic models.

The formal science base as above given, as the first basic model qualifies that of *Systems and Systemics*. Systems thinking acts as a comprising root model. There is virtually no existing or non-existing unit which could not be seen as a system. Systems change in time, if they change their complexity they are seen to evolve or to devolve. Adding to systems time dependent dynamics, *Evolution* represents the second basic model: the process of changing in (pre-) history and the laws governing such change. With a more sophisticated and thorough understanding (see the late Ernst Mayer, but also Edelman) the evolution model, as the systems model, has grown into a general conceptual aspect of several sciences. In consequence both systems and evolution spawned quite numerous hyphen sciences as e.g. systems biology, evolutionary psychology or systems management in business. Evolution happens a process in also in human history (e.g. 'rise and fall'), the concept opening to the anthropologies and humanities. To understand a systems by its actual functional structure (in situ) in addition its emergence in history needs be known. The course of evolution follows a wide variety of algorithms, of rules and regularities (as e.g. in social physics and in psychiatry). In sum the developmental courses may be envisioned symptomatically in the change of complexity. The rules of evolvement thus can roughly be summarized a *Complexity* sciences, including self-reference as well as fractals and the fuzzy systems approach etc. As evolution sciences, complexity sciences often focus on, but are by no means restricted to life, living or viable systems. 'The path of evolution is not specific to biology – it's transferable (Edelman) The concept of complexity helps to grasp the phenomenon of emergence e.g. of new qualities, of phase transitions, of synergetics and synergy. Combining e.g. evolution and complexity approaches recent attempts try to understand evolution e.g. of consciousness as a continual unremitting development, proceeding from a physical base to higher consciousness up to the scientifically not fully accessible 'qualia' (Edelman).

A key phenomenon throughout all these models is – paraphrase N. Wiener – the informational connection between elements of systems and their control. With rising complexity *codices* develop, gradually acquiring *meaning* and developing into proto-languages and *languages*. Basing on philosophers as Pierce, on biologists as v. Uexküll and anthropologists as G. Bateson, semiotics (in particular biosemiotics) are forming as a fourth basic model. Forming e.g. the base of complexity dynamics it may be called here *Semiodynamics* (the author apologizes for the clumsy working term). Semiodynamics, as languaging, opens 'qualia', the not yet measurable atmospheric, mental and religious-spiritual dynamics for cautious scientific attempts. Obviously, this is regarded still as pre-scientific quicksand. Nevertheless, not being able to 'measure' in terms of prevailing scientific paradigms should not cause to discard these phenomena as 'not scientific'. Quite the opposite, it should stimulate to inquire for new inroads, if feasible new paradigms. This area is covered by the fifth still but tentative model, named following Teilhard de Chardin the *Noosphere.*

Taken as a closely entwined set of hypotheses the above models may serve as an *heuristic* frame for reference and exploration. By origin they are transdisciplinary, providing a point of departure for transdisciplinary research also into the very fundaments of the transdisciplinary approach. It should be noted that the qualities of the above models requests concomitantly a reconsideration of the *order of knowledge*. Identification, coding, classification and knowledge order in its entirety are base, symptom and spine of also scientific world views. Virtually there can be nothing in the world what is not predetermined in the order of knowledge and the *ontology* behind. Transdiciplinarity thus demands a tentatively 'universal' base of knowledge order, of *an 'universal classification'*. In turn such universality will need a referent ontology. But that is only one of several issues opening for the science of science.

4. TRANSDISCIPLINARY KNOWLEDGE DEVELOPMENT FOR GLOBAL CULTURE AND INNOVATION

Paraphrasing a common definition: *Culture* may be seen as a specific view on the world, the institutions around and the knowledge order and its ontology on the bottom. Culture forms how to understand oneself in ones world, it establishes the societal roots of individual and societal *identity*. Knowledge order, including beliefs and convictions, directly or indirectly determines the positions claimed: social standing, wealth, power. Social movements give ample examples, as international power play does; e.g. China is unbroken understanding itself as the empire of the middle. Knowledge order inherently implies value systems how matters should be and should be handled. The acknowledged clash of cultures contains a contest of different value scales as well as a different understanding of the order of the world. Well known examples present the positioning of the individual in relation to its community; of man to his environment and his responsibility for himself in his environment.

As the song tells: the Colonels Lady and Judy O'Grady are sisters under the skin. But above the skin? Trouble on Human rights originated from Western culture for example will scarcely be fully accepted by Non-Western value and knowledge orders. 'Westernization' is, in spite of resistance and opposition, spreading. But such transfer phenomena will scarcely give the full answer. As it seems technology based civilization has been an is forcing a common order relating to technology handling. ICT, for paradigmatic example, induces its own order of knowledge, its own logic and perhaps ontological classification. The shared technology however will but set technology defined standards, *not* necessarily give rise to a shared cultural base. Multi-culture seems a contradiction in so as far as it heads for a cultural amalgamation. Needed is a trans-cultural base, establishing a framework against which cultural difference can be understood as a specific realization, a defined type of a general properties of culture. *Transculturality* comes very close to transdisciplinarity, to a culture supporting and complementing the other on the shared base of science and its knowledge, its order of dialogue, of refutation and confirmation. It appears worth to inquire the triangle of ICT, of a possible trans-cultural knowledge order and the contribution transdisciplinarity may give. The path is being paved already by research into societal, cultural, languaging 'universals'. Which qualities, faculties are necessary to establish a society; for instance on the base communication as N. Luhman proposed? Can, for example, universal models of society, or of culture be hypothesized and used as a frame of reference to distinguish the differences which make the difference between cultures? A plethora of research results e.g. from socio-cybernetics (including cultural algorithms) existing is ready to be integrated into a *transcultural knowledge base.*

Summing up*: Systems thinking* again qualifies as the nucleus for *transdisciplinary* science providing an essential base also for *transcultural* understanding and the handling of cultural differences. To develop a knowledge and methods base, the *critical and the dialectical systems* approach for example provide methodical and socio-cultural critical frames for the perpetual dialogue necessary. From the practice of problem solving systems methods have been developed, hard, soft, integrated. From systems modeling and simulation system dynamics or agent based stimulate they comprise also basic research into theory of science and meta-methodology. Again, the beginning integration of such knowledge towards a transdisciplinary and transcultural knowledge system ought be intensified.

When lecturing in India a student asked me what to do when Western technology shaped traits of thought and values do not comply with religious, here the Hindu, belief. The only answer to be given was: go deeper beneath and beyond the actual belief to fundamental axioms of human identity and human convictions. Then try to find not whether, but how, under which preconditions, they will be compatible. As the example points to, the issue is not solely to be solved as a matter of basic beliefs, of knowledge order and of theory of evaluation and judgment. It is also an *essentially pragmatic, operational challenge* to be answered from the practical and operational side: what is, situation given and intent stated, acceptable, feasible and operational? Systems thinking, in its kernel operational, a means to and end, will proved the thought frames apt to bridge science of science with operational pragmatics.

The incident reported brings back to the role of systems, transdisciplinarity and ICT as driver and a carrier towards mastering societal evolution. Whenever seemingly mutually excluding antagonistic positions, values, claims etc. arise, they cannot be solved on the actual level of argumentation. They need find a *creative solution on a superimposed level* – transdisciplinary and/or transcultural – that can be transferred into an *operational innovation*. Creativity and innovations only can *open potentials* for further societal evolution. Any other pseudo-solutions but close them down and constitute the proverbial fish trap. It seems the EU as well as some European countries actually are caught unable to move this way. What would be necessary is to dissolve still prevailing ideologies and their indigenous egotism inherent to nationalism or to socialism. Science is called to prepare the well grounded scientific base to reveal the basic facts needed for sustainable practice action. What makes a society grow or shrink? Or, as the so far latest book of G. Diamond phrased: 'Collapse. How Societies Choose to Fail or Succeed' [10]. ICT is appealed to transfer these facts to the voting public. If necessary showing in parallel how, from ideologist or corporatist interests, the facts are suppressed, distorted, discarded. Thus opening option and action space for the future, which will rest on innovations and innovative action or not happen at all.

5. TRANSDISCIPLINARY LEARNING (GECL) FOR AN INNOVATIVE SOCIETY

Any innovation is the result of a continuous learning process, of the innovation helix. The process of successful innovation, preconditions, course and operation, in industry and business has been in depth analyzed. In contrast societal innovation has been investigated so far mainly from the historical aspect of long range societal evolution. Rise and fall of societies in the pre-history and history context have been dealt with rather exhaustively, up to the recent aforementioned book of Diamond exploring the basic geographic, climatic, demographic and ideological/ constitutional factors. From this research base, however, the transdisciplinarity necessary to understand the *innovative society* becomes obvious. Only on first sight the rise and fall e.g. of the Roman empire can be ascribed to a few causes. On closer inspection a multitude of if densely enmeshed factors contribute. For the history of the previous five hundred years, but the growing funds of *pragmatic information* and of pragmatic information and communication technology mark cultural innovation and the development of society and culture. Knowledge, and in particular *New Knowledge* (distinct from *Confirming Knowledge*) set into motion a helix of *innovative Pragmatic Knowledge,* the last generating and propelling itself by a course of continuous self-organization. One of the driving atmospheric forces appears a newly defined cultural and national identity as well as world wide power competition. Qualities of the *internal societal constitution* favorable to innovation appear e.g. the necessary precondition for a chance of entrepreneurial success and a sufficiently free function of the market, since stimulating and rewarding innovation in the widest meaning. Science provides a means of information acquisition, evaluation and transfer into practice with considerably less hazards than pre-scientific methods. (In fact what is needed is a complement of science with eventually science based intuition). Parallel to developing ICT, information became virtually freely accessible, a valued merchandise itself and a means of competition. The free space necessary for innovation is pre-given by constitutions more ore less close to democracy. They need least permit relative free spaces for the technology and the economic development and for the a sufficiently free ICT behind.

In all phases, *innovative learning relies on transdisciplinary information*. The rising complexity of innovations in an in all aspects highly structured and constrained environment, on the one hand underlines the quest for a highly developed state of ICT dealing with the constraints and the remaining chances. On the other hand innovations will mostly result from a creative (and often complex, intricate) combination of in particular newly developed materials and principles into a innovative principle or product, 'fitting' existing structures.

The inter-connection of science, ICT, political-constitutional and economic factors, determine also the innovation potentials in the societal fields from economy to welfare systems to government and realized constitution. What has to be learned is, first, that any isolated measure of reform will be inefficient and fail. And that, second, ossification has to be loosened, bureaucracy, rule and regulations have to be reduced before any reform can bring forth results. Any other course will lead to obstruction, loss of potentials and will end in a fish trap closing more and more tight. To prevent decline society and the responsible government have to re-learn the basics from systems and systemic thinking. And, last not least, any innovation has to be understood be the public and 'sold' to people, but by gaining their insight.

Epilogue: Guiding our own history

A theme dealing with societal evolution scarcely can avoid political references. Connection to actual developmental problems and fish traps, in reverse, becomes but compulsory when the base of science – taken in the comprehensive meaning of the term - and thus also of society is endangered. Unfortunately that is, for some industrial and emerging countries, no exaggeration. The decline of GDP per caput left is shrinking, that is the remaining amount not tied to taxes and social welfare both costly and inefficient, free to spend for the citizen. Even more dangerous appears the for decennia declining capacity to rejuvenate society. Shielding from the pressure of global competition is shortsighted and doomed to fail. Competition needs be met innovatively, the sooner and the more creative the better. Change comes as unavoidable as it ever did; the more early and active change is guided, if possible by anticipation and leadership, the more successful the attempt to cope with it. Necessarily change and reform will create winners and loosers. That is a reason to balance, but not to delay or discard reforms. In the latter case everybody will loose; not only the existing wealth but the potentials to retain and eventually create new ones will be lost.

Human beings are responsible for the course of their own history. So are societies. As concepts as Guided Evolutional Learning demonstrate, societal learning need be effected in a permanent course of deliberate acting and learning from the results the option and the action spaces for further acting. Science, transdisciplinary science, provides heuristic models. Of course the future is uncertain. But we are in possession of powerful instruments to shed light on the next phases and on long term curves to learn from. We need but employ them. ICT may support efforts to make society constantly aware of the challenges to be met and the chances to do so successfully.

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