Navigating a New Agenda

Questions and Answers on
Paradigm Shifts &
Transformational Change

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1 About this Paper

The new discourse on the need for Transformation and Paradigm Shifts in climate policy and sustainable development is rapidly evolving. Against this backdrop, the Wuppertal Institute is carrying out a study to assess the deeper meaning of such terms and concepts and how practitioners could apply them in capacity development activities. In our discussions with funders, climate experts and consultants, we found that many interpretations of the terms Transformational Change and Paradigm Shift exist, along some confusion about how these link up to or differ from established concepts like sustainable development.

We have collected some "frequently asked questions" from two workshops with practitioners from GIZ and other international development agencies and developed answers in a practice-oriented, yet strongly science-based manner, addressing climate change practitioners rather than scientists already deeply involved in transition research. While a common view in climate and development practice is emerging that financial and capacity support should focus on Transformational Change towards a low carbon development paradigm, it is as yet unclear how the stated goals of a paradigm shift can be operationalised when it comes to designing or selecting specific mitigation and adaptation actions. This is the backdrop against which the following conceptual clarifications have been developed. *Of course they represent just one possible interpretation, which is the one of a complex system view*. We do find, however, that this view gains significant traction in the transformation literature.

The paper starts by laying out a complex system view and its connection with Transformational Change and sustainable development before going into more detail on the qualities of system transformations and possibilities to strategically engage in them.

Its key messages are the following:

» Applying a complex system view will lead to a different analysis of the dynamics behind development *pathways* and potentials to overcome barriers to climate friendly or sustainable outcomes. It emphasises relationships rather than technological-economic facts when describing root causes of system behaviour and the perpetuation of (undesirable) trends.

» Each system is viewed to consist of elements or parts, feedback or connections and a purpose influencing what it is set out to achieve - the "grammar" of the development trajectory. The boundaries of a system therefore emerge and change with the purpose, which also influences the manifold self-stabilising feedback loops that create resistance to change.

» System elements are of material and immaterial quality, including energy and information stocks and flows. For analytical purposes it is helpful to define them and their influencing relationships for multiple dimensions: technological, economic, ecological, socio-political and cultural.

» Transformational change will alter the dynamic configuration of all elements, so not only which outcome is delivered but also the processes through which it is delivered. This usually requires a "repurposing" of the system or a paradigm shift: seeing how the system could function differently, if xyz was done.

» Given the multiple self-stabilising feedback loops or path dependencies, rhetorical declarations of a needed paradigm shift will not turn into lived transformational change unless a certain degree of irritation, imbalance or crisis provides a window of opportunity. From this view, crisis and opportunity and irritation and innovation go hand in hand. Normative judgments will define if the resulting change is desirable or not, well- or mal-intended.

» In order to navigate or even trigger such windows of opportunity strategically and intentionally, change agents need to formulate the foreseen paradigm shift and how the system could alternatively look like and perform. This is why intentional Transformational Change depends on soft factors like worldviews, beliefs, knowledge and vision in addition to typical sources of influence.

» Given the many qualitative or immaterial aspects that determine system behaviour and development pathways, intentional change strategies need non-quantitative measures to address socio-cultural belief systems and values, foster learning and development of skills, build new relationships, role definitions and institutional procedures and be sensitive to power relations.

2 Why Transformational Change?

"...transformation is considered most effective when it reflects a country's own visions"
—IPCC

The terms Paradigm Shift, Great Transformation, Great Transition or Transformational Change are used to express the idea that previous intentions and initiatives for tackling negative trends in social, environmental and economic development have been insufficient. From a historical point of view, the level of change to established development pathways would need to be significantly intensified, adopting a holistic and historical perspective in order to identify where the potentials for deep and systemic change lie:

"*Transformations in economic, social, technological, and political decisions and actions can enable climate-resilient pathways (high confidence) ...At the national level, transformation is considered most effective when it reflects a country's own visions and approaches to achieving sustainable development in accordance with their national circumstances and priorities. Transformations to sustainability are considered to benefit from iterative learning, deliberative processes, and innovation*" (IPCC, Assessment Report 5, 2014, Working Group II, C-2).

"*A transition to sustainability demands profound changes in understanding, interpretative frameworks and broader cultural values, just as it requires transformations in the practices, institutions and social structures that regulate and coordinate individual behavior*" (UNEP GEO 5 Report, 2012, p. 447).

3 Systems

What is a system?

Complex, living systems are sets of elements interconnected in such a way that they form boundary-maintaining entities with patterns of behaviour geared at producing an outcome. Each system is composed of three types of elements or components: parts, connections and purpose. Parts need not be of material quality. They can also, for example, be people, stored information, knowledge or virtual money. Accumulations of parts, material or immaterial, are viewed as *stocks* of resources that can be drawn on as the system functions. The types of interconnections or feedback loops between are called *flows*, which can be energy, material or information. They determine changes in each stock's quality or quantity, depending on their inter-relations or feedback loops. The system's *purpose* determines what it is organised to achieve (e.g. survival, photosynthesis, winning a game, providing good education, profit-making, or climate protection). Understanding a system's purpose is therefore essential when seeking to understand its rules and the quality of its feedback structures.

There are also mechanical types of systems requiring different analyses and strategies for change. They show behaviour that can be planned and anticipated, even if they can become very complicated (such as planetary movements as seen from the terrestrial surface). Once those plans are good, very reliable instructions on causal relationships can be developed (e.g. once the model of our solar system assumes that all planets circle around the sun – and not the earth – then the orbits can be described with high accuracy). The category of complex systems, however, shows dynamic, non-linear and at least partly unpredictable behaviour. Into this category falls the Earth's climate system, but also a soccer team, a university, a business or a society.

All living systems are embedded into and connected with other systems. Delineating of boundaries is always challenging and will therefore depend on the actual problem or context in which one seeks to focus attention and work. The actual task should also determine the degree of complexity that is useful. Yet, one should seek for a perspective as holistic as possible to avoid blind spots, thus include institutional, cultural, technological, economic and ecologic aspects relevant to understanding this particular problem and the relevant system's behaviour or development path (see also IPCC and GEO 5 definitions). Meanwhile, even the most detailed system visualisation will be a simplification of the real world and will also differ with a particular person's worldview.

Why is a system view helpful in capacity building for Transformational Change?

The urge for Transformational Change results from the observation that 40 years of pursuing the sustainable development agenda has not managed to reach the defined goals. Searching for the origins of persistent problems, scientific advances in Earth System Science and Social Sciences as well as the concrete experiences of practitioners throughout those years indicate some core commonalities that taking a system perspective can help overcome: The emphasis lies less on *describing* and counting single material or economic parts and human beings in ever more detail, but rather to aim at *understanding* their behaviour and in particular the dynamic *relationships* between them. This view leads to different explanations of long-standing persistent problems and new ideas on how to change their root causes (e.g. knowing more about the negative impacts does not lead to different behaviour if social norms are geared to a continuation of unsustainable solutions). It means *asking what-if questions* about possible future behaviours rather than making quantitative linear predictions. It also implies a cultural shift away from blaming single actors or events to searching for structural patterns keeping all actors from achieving what they might individually ascribe to.

Some problems simply refuse to go away because they are rooted in the internal structure of complex systems (root causes) and since most systems are embedded in larger systems, finding a "solution" in a particular case may cause more problems. Thus, everyone can act perfectly dutifully and rationally and with good intent and still these actions may add up to unintended side effects or deficient results that no one wants. As system science expert Donella Meadows sums up: "*No one deliberately creates those problems, no one wants them to persist, but they persist nonetheless. That is because they are intrinsically system problems – undesirable behaviours characteristic of the system structures that produce them. They will yield only as we reclaim our intuition, stop casting blame, see the system as the*

source of its own problems, and find the courage and wisdom to restructure it" (2008, p.4).

How do tipping points relate to Transformational Change?

Systems in dynamic equilibrium are rather stable because of the many interconnections between parts, which translate into self-reinforcing feedback loops or path dependencies. These include biophysical developments as much as certain ideas about individual roles in a system and the choice of perspective and values (see **paradigms**) coupled with norms and rules as to "how things have to be done" or structural interconnections like different stages of production in a value chain. Tipping points are also called "the moment of critical mass" or a "threshold" and are considered as windows of opportunity because at this stage of system development the dynamic equilibrium becomes brittle. Gradual changes slowly erode the strength of dominant feedback loops or the quality of parts until their functioning along former paths becomes difficult or impossible. What is a crisis from the perspective of a system's self-organising intention therefore also translates into an opportunity for changing the feedback loops or path dependencies behind it.

Tipping points can have different origins, for example:

» gradually emerging *material or immaterial challenges to a system's purpose and functioning*, such as shortages of fossil fuels or the arrival of new knowledge about the damaging effect of too much CO_2;

» *contestation* about the desirability of a system's purpose and/or its actual outcomes giving rise to deviating actions by people within or from outside a system who disagree, e.g. with distribution effects of a particular growth development model;

» sudden *external shocks* like financial turmoil or Fukushima that immediately threaten the system's continued functioning or aggravate the recognition of certain risks or conflicts of interest, e.g. a renewed swell of the long-standing anti-nuclear protests in Germany.

Usually, several of these irritations will co-evolve and often reinforce each other. Some can be buffered by stable systems, at least for a certain amount of time and as long as its stocks are not run down and can function like saving accounts, which can be drawn on for some time without harm to the system's reproduction (e.g. healthy soils convertible for food production serving a growing world population, or the cultural narrative that yet more growth in wealth for the rich will also trickle down to the poor). But when irritations become too manifold or persist for too long, the system capacities to balance and buffer slowly become stretched before turning brittle.

One example of humanity risking an undesirable tipping point concerns the capacity of the Earth's ecosystems to keep the CO_2 cycle within a certain threshold of parts-per-million (ppm) so that current climatic patterns remain relatively stable and predictable. Since cause-effect relations in still stable complex systems show a delay (due to the buffering stocks) it is often difficult to identify and communicate necessary changes before crises become tangible.

Reaching a tipping point does not necessarily lead to Transformational Change, at least not in social systems. It first means that things get chaotic, rather unpredictable and without many recognisable patterns. Depending on the changes and interventions following from this, either dynamic balance is renewed, of transformed or relapsed quality, or the system may break down. Making and executing plans for interventions during such a period is difficult though, as a great deal of change takes place at the same time, making tipping points the start of transition phases (see **Transformational Change**). Strategic engagement for Transformational Change therefore seeks to prepare ideas, plans and coalitions before reaching the point – albeit it is not easy to anticipate due to the complex system behaviour; hence the notion of thresholds rather than single numbers.

What is the difference between system transformation and societal transformation?

The difference lies in the scale of the problem addressed. Depending on the system worked with, its innovation amounts to a Transformational Change across all of the five analytical dimensions, leading to its repurposing. Many of such smaller system transformations are building blocks in overarching societal transformation. They amount to small-scale alternative solutions and through their embeddedness into the overarching societal system usually create ripple effects there as well, in particular if the actors involved are pursuing a political intent that involves challenging overarching system dynamics. In these moments they have the effects of internal irritations in the societal system and its status quo.

What is the difference between Transformational Change and sustainable development?

Transformational change is a descriptive concept defined as a structural change that alters the interplay of institutional, cultural, technological, economic and ecologic dimensions of a given system from one dynamic ordering into another. Such change may be gradual or abrupt, driven by system-immanent frictions or outside pressures and can be intentionally pursued by actors in a system, who have a vision of a different, preferred system state. It will discontinue former development paths, including social practices and worldviews. Transformational change therefore amounts to a system transformation and involves a paradigm shift. Which outcomes Transformational Change

has is irrelevant to the concept as such even though most proponents will argue that their intended outcomes are "better" from their point of view, for example the sustainable development community. Since transformational interventions mean breaking with current path dependencies and therefore normalities that people are accustomed to, many proponents describe the change they foresee as "possibly worse before then definitely better": they argue for partially disruptive interventions in order to prevent threatening system crisis or collapse. One example would be to raise resource or energy prices in order to avoid their overexploitation, even if this leads to higher household expenditures and the discontinuation of particular product lines or business models.

Sustainable development is a normative concept defined as development which meets "the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, 8). Additional emphasis is given to two issues: "the concept of 'needs', in particular the essential needs of the world's poor," to whom "overriding priority should be given" and "the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs" (WCED 1987, 43). Which level of change is required in order to reach this normative outcome is contextually different and irrelevant to the concept as such, even though its principles describe positive interventions with wide stakeholder support and equitable sharing of burdens and benefits.

The terms are often used jointly and sometimes without making the distinction between descriptive versus normative quality. This is probably due to the observation of many (as the GEO 5 and IPCC reports show) that given today's development paths nothing less than Transformational Changes are required to reach sustainable development outcomes.

4 Levels of Change

What makes Transformational Change more "radical" than "normal" change?

Change is a container term for anything that is novel or different. It does not necessarily imply an impact on the general trajectory that a system is evolving on. These trajectories result from the multiple path dependencies and feedback-loops discussed above.

All "normal change" solutions keep line with the purpose driving the self-organising dynamics of a system. What is aimed for is a change in outcome, but not necessarily of the processes that lie behind the outcome. The general **paradigm** and existing standards on how to do things are not challenged, the old path dependencies remain intact, and the same pattern of development is to be expected.

Transformational change, however, means discontinuing path dependencies and changing dominant feedback loops so that the entire set-up of what is aimed for and how will be different. Think about the difference between change aiming at making an energy system less CO_2 intensive (change the outcome) to turning energy provision into a public good that should be delivered on sustainably and reliably (change the paradigm) and therefore which degree and dimensions of change need to be addressed.

Transformational change processes may be unfolding without much prior attention or be the result of anticipatory intentional change strategies. The latter is what capacity building and leadership for Transformational Change are about. Both require a long-term view as to how this system could look differently and what its outcomes would be.

Engaging for Transformational Change will work from such a vision of an alternative purpose or paradigm to tackle some of the existing path dependencies head-on, seeking to unlock them, so that the alternative way of seeing and doing things becomes tangible. Such processes are medium- to long term and usually require a portfolio of Interventions: hardly any single project can address all aspects at the same time.

Think about the energy system vision. Depending on the concrete context it could require, for example,

» slashing subsidies or tax breaks for fossil energy sources so that renewable energy solutions and their business models are given a level playing field (economic and technology as well as socio-political dimension);

» mobilise investments into the renewal of the grid and storage system so that it meets the requirements of renewable energy (technology and infrastructure as well as economic dimension);

» acknowledging limitations to resource availability in line with the carrying capacity of the planet and seek to find an energy mix that respects such safeguards (ecological, technological and socio-political dimensions);

» find sufficient supporters to back the policy- and investment interventions necessary and to address lobbying efforts of the losing put powerful fossil fuel industry (socio-political and cultural dimension with knowledge, beliefs and values).

Thinking about this example, we easily see that transformative change is often very difficult to introduce without a crisis (see tipping points): why should we embark on such efforts if everything is running rather smoothly? Intentional Transformational Change is therefore usually the result of "radical incremental change" driven by a few pioneering actors with the clear long-term problem awareness and goal to discontinue the path dependencies leading a system towards it. The quality of transformational change strategy has therefore been described as adaptive management flexible enough to work with emerging system dynamic changes and unintended consequences. The "radical" component lies in the clear goal or vision to repurpose what the system is set to deliver and how.

What is a Paradigm Shift?

In scientific terms, paradigms comprise assumptions that are epistemological (what can we know), ontological (what can be said to exist and how do we group it), and methodological (which guideline framework for solving a problem is suitable). In the context of social change many add axiological aspects (which values are adopted). Depending on how these are defined, one and the same event will be interpreted very differently: If I believe that humans are by nature selfish and greedy, for example, my interpretation of events will differ from one where my premise is that humans develop behaviour according to the social context they live in and are very much capable of being altruistic and sharing but may simply not know about particular consequences of their actions.

The person most identified with the term is Thomas Kuhn, who in 1962 wrote a book called *The Structure of Scientific Revolutions* in which he described how several paradigms and therefore understanding and explanation of how the world works tend to exist in parallel. Yet, one tends to become dominant and informs which standard ways of thinking about things and doing things becomes part of our educational system, socio-political norms, rules and laws. It provides the beliefs and knowledge with which humans make sense and orientate their behaviour.

In system change literature, Donella Meadows defined a paradigm as "*the shared idea in the minds of society, the great big unstated assumptions, constitute that society's paradigm, or deepest set of beliefs about how the world works. These beliefs are unstated because it is unnecessary to state them – everyone already knows them*" (Meadows 2008, p. 162-163). Once these reference frameworks shift, the adequacy of existing institutions are scrutinised, including the goals they are after and the processes they rest upon. Many new solutions that were formerly unthinkable become possible alternatives. Tying it back to energy again: the vision of renewable energy systems at all being a viable alternative has very long been declared utopian and unfeasible, as was the idea that the production of energy could be done by the consumers themselves.

Why does a paradigm shift ignite Transformational Change?

A paradigm shift resembles a transformed framework of reference with respect to which questions will be asked when assessing a certain issue and how they will be asked, what will be observed and how these results will be interpreted. It creates a new perspective on the possible and is therefore essential in intentional strategies for Transformational Change. It leads to a review of existing rules, standards, processes and ideas with regard to their adequacy in reaching a system's new purpose, impacting all levels for strategic interventions

from technology choice to strategic coalition building to institutional re-design.

Here, however, it is important to distinguish between rhetorically declared new purposes like ambitious CO_2 reductions and climate resilience and the persistence of formerly lived ones, including their manifestation in rules, indicators, practices, standards across all five analytical dimensions of systems. As long as many of those remain wired towards the former purpose, e.g. economic growth, not much Transformational Change will come around until the discrepancy between rhetoric and practice is closed. Here we see the connection between theory and practice or ways of seeing things and ways of doing things.

How does Transformational Change relate to a Great Transformation?

The term Great Transformation was originally introduced by Hungarian political economist Karl Polanyi in his 1944 book "The Great Transformation. The Political and Economic Origins of our Time." It describes what Polanyi saw to be a complete overhaul of the core operating principles of societies, the very foundations of social interactions and its institutions, resource bases, production capacities, knowledge frameworks and value sets. The particular transformation he analyses is the emergence of an industrialist market society - sometimes he also calls it capitalist market society - and how it was institutionally enshrined into democratic states from the late 18th Century onwards.

While applying a historic point of view, his work does not reconstruct a sequence of events in the most accurate manner, but seeks to identify trends in the emergence of human institutions. For this, Polanyi blends description of real world developments as well as core theoretical concepts and explanations of influential thinkers. His account therefore shows how creative and reflective actors seek to provide explanations for the observed happenings and in doing so also influence the socio-political responses, sometimes very explicitly (see *paradigm shift*). More recent studies using the term "Great Transformation" (like the 2011 WBGU report to the German government) often pull up short in comparison to this holistic view and exclude the question of economic structures or dominance of particular worldviews (see *paradigm*) in social change processes.

Transferring Polanyi's general approach of working with such a holistic view to specific systems and settings, however, allows one to work on Transformational Change without having to aim at changing an entire society. In fact, most transformation researchers will

doubt that intentional change of entire societies can be planned and rolled out. Instead, many unpredictable developments will take place and the process is more one of intentional and vision-driven innovation, learning and adaptation that is also riddled with political struggles. Working for Transformational Change therefore means paying particular attention to the ideas, cultural norms, taboos and power structures that operate as feedback loops in unsustainable development paths and that often go unnoticed in economic-technological change strategies.

5 Interventions for System Transformation

Is transformation intrinsically or extrinsically driven?

Transformational change can be driven from within the system as much as be ignited by changes in the environment into which the system is embedded (see definition *Transformational Change*). To strategically drive transformation and to stabilise a particularly desirable outcome, however, the conscious engagement of actors from within the system is important. Without them participating in setting out new ideas, rules, norms, standards and technologies that can replace the former feedback loops and some elements the new system dynamic will remain brittle. If the new ordering is only maintained because of external influence, coercion or conditionality no stable equilibrium behind a self-organising purpose will be reached. This usually means that fully lived Transformational Change will take longer and even if rhetorically consensus on a new purpose or paradigm prevails it will take time until it has been worked into a restructuring of the system.

Can incremental change be transformational?

Yes, mostly, Transformational Change is the result of incremental preceding steps. Even when looking at revolutions, one finds a plethora of irritations from within or a looming threat from outside the system, which have often been in place long before some event (often a rather small event) triggers a *tipping point*. Consider the Arab Spring: one Tunisian fruit seller setting himself on fire would not have caused a revolution if not for the other system irritations and incongruities that sparked a social tipping point. Slowly but surely incrementally rising CO_2 emissions, which do not have very significant impact when

looking at each and every source, are pushing the climatic system towards tipping points and massive Transformational Change.

With a clear intention to transform given path dependencies in a system, small, repetitive and (in the best case) mutually reinforcing projects and changes can result in a complete overhaul of a system dynamic and development trajectory. Often this will involve a tipping point with high frictions and politicisation – but it will not necessarily lead to destruction or violence, for which the fall of the Berlin Wall provides a classic example (also see **transformational vs. "normal" change**).

Another example may be the successive support for renewable energy systems in Germany, which started with small pilot programmes for single technologies. These pilot programmes enabled some pioneering business models, which then encouraged politicians to introduce a full-fledged long-term regulatory intervention, with the goal of dramatically increasing the share of renewables in the German power sector. This action created positive, reinforcing feedback loops for technology breakthroughs never anticipated by the fossil-fuel industry (which would otherwise have opposed the legislation), and many different new business models driving technology into the market and to end-consumers. In parallel to renewables becoming visible and their potential acknowledged, in the political sphere, more and more ambitious long-term targets were formulated.

Currently, wind and solar are in the process of transforming from niche into mainstream technologies. The share of renewables in the power sector is so high, that more and more fundamental regulations have to be reworked. The current discussion is less about changing individual support policy but increasingly about generally reframing the overall market design in the German power sector. Step by step a new tipping point in the new system trajectory has been reached. The overall process of energy system transformation has already lasted more than 25 years and will most probably continue for several decades.

What are leverage points?

Leverage points are places for intervention in a system that will have influence on its overall behaviour and therefore are likely to facilitate Transformational Change. They can be found at specific system elements, or in the connections among them. Since all Transformational Change will cause resistance (self-stabilising loops in highly differentiated processes but also fear of change, loss of power and privileges), a leverage point strategy should pay particular attention to the anticipated willingness to learn or resistance to change in the given

system and the parts and feedbacks that should be expected to work in favour or against the intended interventions.

Recommendations by system innovation experts as to where to look for effective leverage points include: check for high concentrations of knowledge or/and power (Geoff Mulgan, 2013), map the most influential actors within your system boundaries or "transition arena" (Derk Loorbach, 2010) or apply an "iceberg" assessment of patterns, trends, drivers of change and mental models when seeking to understand a current event and potentials to solving the problems it brings about (Gilbert Probst and Andrea Bassi, 2014). Donella Meadows has also developed a "layered" list of leverage points in which the higher ones have impact on the lower ones (reverse order from the iceberg) and starting from quantitative numbers whilst ending up with the overall goal of a system and the paradigm informing both its definition and the ideas how best to achieve it (see **paradigm shift**). According to Donella Meadows (2008), the highest leverage point of all is the transcendence of the idea that there is one correct paradigm: keeping ones mindset open to develop new knowledge and ideas in line with the emergence of new system dynamics safeguards the potential for most radical transformations.

What are time frames in which Transformational Change happens?

Mostly we only start paying attention to Transformational Change when problems are already visible. In order to strategically engage in it one needs to trace back which changes have been ongoing for which time-span and when transformational quality came into them.

Time frames for transformation processes then depend on several aspects and answering three questions seems particularly important for the planning of interventions:

» **1. Which stage is the system in?** Depending on which state a system is in when one starts working on transforming it (from stability phase to increasing friction phase, to a rather chaotic transition phase to re-stabilisation or relapse phase), Transformational Change will take longer or may be immediately ahead. Also, transition phases leading to relapse at one point do not exclude subsequent "rounds" of system challenge where the next tipping point will enable more radical system transformation to take place.

A phase model on transformation processes is one key tool described in the guidebook "Shifting Paradigms".

» **2. Which scale does the transformation address?** Depending on the size of the system analysed its change will take longer, in particular if many subsystems keep on pushing into another direction and make agreements difficult. This is why many protagonists

working for transformation focus on strategic pioneer management first, helping the transformation of small systems before coalitions become likely that could drive the change of overarching regime system changes.

» **3. Are there risk hierarchies that should guide priorities?**
Depending on the limits to intentional change, crises or tipping points in one analytical dimension of systems will have more radical implications than others. In particular Earth System laws are not bound to human intentional change and their unfolding will not be negotiated. This is the reason why many scientists argue for a view on systems in which the environment provides the basis of all life whereas social and economic systems need to align their logics with that of natural reproduction circuits.

How can we measure transformational impact?

Measurement concerns the assignment of numbers to objects or events and is a cornerstone of most natural sciences, technology, economics, and quantitative research in other social sciences.

Transformational Change, however, is a process that happens across multiple dimensions of a given system. Some elements, e.g. in the technology or economics dimensions and some ecological aspects can be measured quantitatively, like existing and newly built infrastructure, monetary flows, or emissions of pollutants. Others can best be described in qualitative terms, e.g. rules, roles and power relations within the institutional dimensions as much as socio-cultural factors like how people perceive the world, what they believe to be possible or just, and which values and quality of relationships to the environment or other people and countries they hold. The growing literature on social innovation, for example, points to the importance that new skills, new relationships, better understanding of system connections and more trust between actors have for the resilience and effectiveness of change processes (BEPA, 2011).

Thus, Transformational Change involves not only changes in outcome, but also changes in processes with which outcomes are achieved, including how the people perceive and therefore support or reject both; the feedback loops and path dependencies that impact how stocks and flows of the system are connected and influence its behaviour. Without addressing these rather intangible drivers many interventions will not generate transformational impact but run into unexpected barriers, cause unexpected resistance or unintended side-effects.

Since the term "measurement" is so restricted to quantitative approaches, it might therefore be helpful to speak of indicators for planning, enacting or selecting interventions for Transformational Change. They are important communicative tools as much as process management tools by helping to

» a) understand the problem and the system that one needs to work with,
» b) build a joint vision as to where a promising pathway of transformation lies, and
» c) support monitoring the success or failure in getting there.

Together, such indicators should amount to a helpful information system and should not only include numbers but also descriptions that can capture the less material dimensions of system behaviour.

The search for such a comprehensive indicator set could be guided by distinguishing three qualitative categories (see, e.g. GEO5, 2012):

» 1. The core technical-economic-ecological data informed by natural sciences (amount of CO_2, the amount of funding in the energy sector, the type of resources available and at which price, the standards of energy intensity for appliances etc.)

» 2. The socio-political frameworks informed by the patterns and trends that social sciences help anticipate (which governance set-ups block learning out of the box, which incentives work as accelerating feedback on trends countering your goals; which relationships hamper the inclusion of innovative on-the-ground knowledge and buy-in etc.)

» 3. The deeply rooted worldviews and behavioural aspects that humanities and cultural sciences deliver insight on (which belief systems and cultural conventions prevail, how did they evolve over time, how do they support particular policies or standards etc.)

The transformational impact increases from 1 to 3: only upping the money or increasing the standard of energy intensity will not address drivers of overconsumption and loop holes in regulations whereas overcoming those will often depend on support which is influenced by knowledge, conceptions of justice and cultural aspects like lifestyle choices. Changing the latter successfully, on the other hand, amounts to a *paradigm shift* and will lead to a thorough challenge of the validity of existing standards and possibly also of the quantitative measures of success (see Meadows 2008 on Leverage Points).

Defining meaningful and good indicators especially for category 2 and 3 can hardly be done without engaging directly with actors in the system one wishes to work with. Collaborative and at best multi-stakeholder processes are therefore vital. They lead to a better understanding of the system behaviour for external supporters (i.e. establishing a transformative literacy of the targeted context), create mutual understanding about subjective ideas and aspirations among core change agents in the targeted system (learning and relationships), and lead to more buy-in, capacity building and ownership of the actors or groups involved (more resilient change process).

As a consequence, Transformational Change can only partly be measured and mostly assessed. Each indicator set for strategic interventions will have to be defined in accordance with the specific system tackled. Especially the socio-political and cultural aspects but also ecological preconditions vary so much between contexts that generalized criteria would hardly be meaningful. As an example: what might be very promising in a system with sufficient frictions so it is "ready to change" or close to a tipping point might might be utterly ineffective in a setting where the system is in a rather stable state of self-reproduction (see *How do tipping points relate to Transformational Change?*).

The Guidebook *"Shifting Paradigms: Unpacking Transformation for Climate Action"* (Mersmann et al. 2014) developed in parallel to this paper provides some assessment tools for the planning of interventions in line with a complex system view as discussed here. The definition of some key process criteria for their successful usage will be an important next step in an already active debate.

http://wupperinst.org/en/projects/details/wi/p/s/pd/482/

FURTHER READING

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