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Societal Innovation: between dream and reality lies complexity

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Abstract

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"If anyone wishes to search out the truth of all things in earnest, he ought not to select one special science, for all the sciences are co-joint and interdependent"

Descartes, Rules for the Direction of the Mind, 1629

Inaugural Speech
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Abstract

There are no easy, off-the-shelf solutions for persistent societal problems, because these are caused by fundamental flaws in our societal systems. Such systemic errors demand radical changes in our thinking and actions, i.e. transitions and system innovations. Transitions require a long period (one to two generations), and take time, patience, money, confidence, but also courage, daring and perseverance to gain the upper hand over various types of resistance.

Research into transitions is by definition multidisciplinary and interdisciplinary. For this we need knowledge and experience from systems analysis, social administration, history, innovation science, economics, business administration and technology. The nature of research into transitions is fundamental, explorative, creative and practical.

A conceptual framework for research into transitions is presented that consists of four interlinked conceptual building blocks, which in turn provide an outline of a transition theory in its embryonic stages. These concepts are rooted in common notions from complexity theory, new forms of governance and social theory. Central here is the concept of transition management, for which a new management framework is developed.

Transition management is an attempt to tackle persistent stubborn problems by steering them in a more sustainable direction, through a visionary, cyclical process of agenda building, learning, instrumenting and experimenting. Not based on management and control but through clever, subtle changes and adjustments at several levels concurrently. Transition management is a very promising management concept that can initially be applied to a wide range of complex societal problems: from health care to energy provision, and from social security to mobility. Transition management can also be applied to complex processes of change in a business context.

The societal challenge

The Netherlands is facing a daunting societal challenge, namely: in what kind of society would we like to live in the future? This is related to the following question: how do we structure and manage a sustainable society? A sustainable society presupposes a clear balance between economic, ecological and social development. It is now evident that the rapid advancements our country has experienced in the last century have not led to a more sustainable society. Various symptoms of unsustainability have surfaced here and there, and I would like to dwell on just two examples, one at the micro and the other at the macro level. A recent online survey among 150,000 Dutchmen revealed that the vast majority of them were not happy with the structure of society as it is today. They gave aspects like the 'quality of well being' and 'solidarity' precedence over more wealth and economic growth (Eijk 2005). The recently published findings of the global study 'Millennium Ecosystem Assessment' indicated that mankind has changed ecosystems much faster and more drastically in the last 50 years than in any other period in human history. This pressure will only increase in the next 50 years due to an overall increase in the global population, economic growth and the resulting increasing demand for ecosystem functions such as food, water, energy and wood (Reid 2005). This message is by no means new – the warning has already been issued on several occasions, ever since the report of the Club of Rome was published. What is new, however, is the growing awareness that this increasing pressure brought about by man's urge for expansion could lead to sudden changes (discontinuities, surprises), which will pose a serious threat to mankind. Examples of this include the outbreak of new diseases, changes in the regional climate and plummeting stocks of fish.

The challenge of creating a sustainable society could possibly be compared to that of issues related to social, educational and voting rights, which emerged at the close of the nineteenth century (Schot 1998). The modernization process that was put into action at that time now needs a new impetus and course, namely sustainable modernization. This requires wide-ranging societal renewal, which I would like to refer to as societal innovation. Societal innovation can however not be imposed from above, but comes about as a process of interaction between a large number of interested parties at various scale levels. Such a process can rapidly get bogged down in marginal changes. Societal innovation requires many small adjustments that culminate in fundamental changes in the broadest sense imaginable. These fundamental changes would have to constitute the basis for a sustainable process of modernization. That

sustainable basis consists of economic, technological, institutional and ecological as well as cultural components, which need to be further fleshed out. This could be done by following on from the necessary positive trends and developments that have taken place since the 1970s, such as: the decoupling of economic activities on the one hand and environmental pressure and the pressure of the surroundings on the other; the emergence of the phenomenon known as corporate social responsibility (CSR); public-private forms of cooperation in large infrastructural projects in which the interests of the government and those of the business community go hand in hand; the emergence of new networks with a great potential for providing direction in relation to a new role for the government and the breakthroughs brought about by developments in areas such as ICT, biotechnology and energy technology. These have contributed to incremental improvements in scores of societal domains and sectors. At the same time, these sectors and domains have to grapple with persistent, structural problems, whose symptoms are becoming more and more apparent. I will proceed to examine these persistent problems at the level of societal systems.

The nature of the problem

What is actually wrong with the public systems in the Netherlands? Changes in systems are generally accompanied by a promise of greater efficiency, improvement in quality, lower prices, more customer-oriented working methods and more innovation. However, this goal is hardly ever attained and we can ask ourselves why. Complex systems such as the National Health service, the social security system, the building industry, the energy sector, the educational system, energy systems, transport services, agriculture and water management all grapple with the same category of problems. Of course, each of these wrestles with individual problems in a peculiar context and has a characteristic structure and dynamics, but whoever observes keenly and analyses critically also notices a number of general characteristics, in addition to specific differences:

(i) the problems that are identified have been there for a long period, usually for decades;
(ii) many parties are involved in the coordination of these sectors/systems, but the individual parties' scope for managing these systems is relatively limited;
(iii) the relationship between those involved is well established for the most part, and there is hardly any room for manoeuvre;
(iv) parties generally take part in lengthy negotiations about short-term, incremental renewals or improvements of the existing order;
(v) there is no coherent vision on the long-term future of the specific system;
(vi) for a long time, problems have been addressed by the same actors, following the same outdated rules of the game, within the same old-fashioned institutions;
(vii) the complexity and corresponding uncertainty are not adequately recognized and seen through by the parties involved;
(viii) the supplier's interests weigh more than those of end-users;
(ix) the end-user has no real freedom of choice and say, and
(x) economic interests and values take precedence over societal interests and values.

The above-mentioned societal factors are characteristic of persistent problems. (Dirven, Rotmans and Verkaik 2002). Persistent problems are *complex* [multiple causes and consequences, their reach stretches beyond a wide range of societal domains and scale levels, and they are deeply embedded in our societal structures and institutions], *uncertain* [they have no ready-made solutions, and it is hardly ever possible to reduce

the degree of uncertainty by acquiring more knowledge, since every attempt at finding a solution only ends up changing the way the problem is perceived], *difficult to manage* [a large number of different actors with diverse interests are involved and each tries to influence the other. These actors are relatively autonomous and operate at different scale levels] and *hard to grasp* [difficult to interpret, ill-structured and susceptible to powerful dynamics in their surroundings]. Persistent problems are as a matter of fact, the superlative form of what Rittel and Webber (Rittel and Webber 1973) refer to as 'wicked problems'; their interrelationship to other societal problems and their entrenchment in our societal structures and institutions makes it impossible to analyse and solve them in isolation. Persistent problems could generally be considered to be symptoms of an unsustainable society. Examples of the manifestations of persistent problems include: floods and periods of drought, animal diseases such as bird flu, mad cow disease and foot-and-mouth disease, traffic congestion and air pollution due to increased mobility, longer waiting lists and overspending in the healthcare system, fraud and construction errors in the construction industry, an environmentally-unfriendly energy supply. These symptoms are aspects of what (Beck 1999) calls the 'global risk society', which cannot adequately deal with the large societal risks that creep into our systems.

These persistent problems can not be solved using *only* current policies (Ministry of Housing, Spatial planning and Environment 2002) (Social and Economic Council of the Netherlands 2001). The current market-based way of thinking cannot solve these persistent problems, because this way of thinking focuses on improving efficiency and maximizing profits, thus bypassing other aspects of sustainability. From the point of view of sustainability, it would be necessary to articulate the future supply and demand of products, which, in many cases, is difficult to do. As a result, there is no properly-functioning market and there is no functional supply and demand mechanism. Therefore existing policies are necessary, but not sufficient: much more is needed.

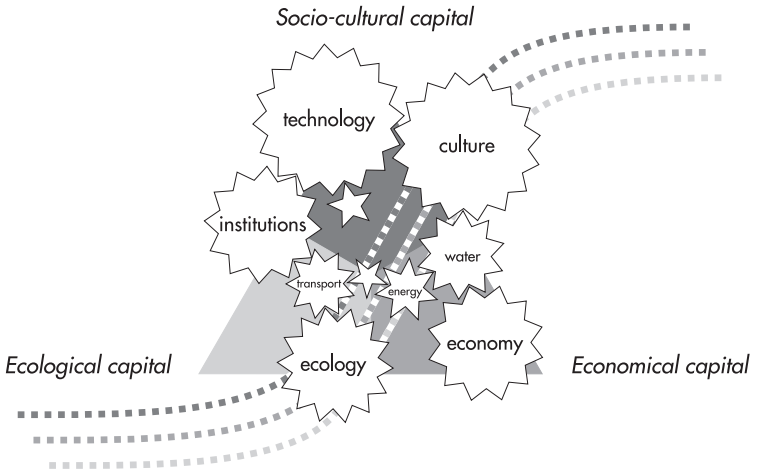

Figure 1 Transitions as societal cogwheels that strengthen one another (Rotmans 2003)

These problems are not just typical of the Netherlands – they have an international character. What *is* typical of the Netherlands is the 'consensus democracy' and its sublimation in the form of the polder model. In this model, consensus is sought by means of elaborate public inquiry procedures and forms of participation, on the basis of broad societal support. This pursuit of consensus is often long and frustrating and generally culminates in huge delays in decision making, because of the numerous public enquiry procedures that it requires. This polder model and the underlying consensus democracy, is corporatist and primarily represents vested interests, as a result of which innovative attempts at introducing reforms almost always fail. Consensus democracy therefore has an enormous ability to hinder and diminish creative power (Berkhout 2002; Schoo 2004). It has been evident for several decades that the Dutch consensus democracy is not really capable of implementing fundamental changes. Even where the polder model has proved its worth, with respect to short term financial-economic issues, especially in the area of wage negotiations, it has not been useful when it comes to tackling persistent problems.

Here, we're referring to the so-called *boomerang-effect*' (Rotmans 2003): deliberations on persistent problems have been going on for decades in the Netherlands, without these ever leading to an effective way of dealing with the problems. On the contrary, they always come back onto the political agenda after a while, in a more serious form. The Dutch Disablement Insurance Act problem is a good example of this – it has been on the political agenda since the 1960s and the scope and seriousness of the problem have merely increased. A practical solution is still a long way off. Another good example relates to mobility; this year, it is exactly 50 years since the first traffic jam. This problem has grown by leaps and bounds and now one can't imagine Dutch society without it (Kemp and Rotmans 2004).

In summary, we are confronted by multiple, compounded problems, and their nature is now different from what it was in the past; the context has changed and current approaches are not able to adequately address the complexity of today's society. From a systems perspective, we identified an accumulation of system failures, flaws in our public systems. In contrast with market failures, these system failures cannot be corrected by the market, since there is no correction mechanism. Due to the persistence and accumulation of system failures, we can speak of a systems crisis, as indicated by Herman Wijffels (Wijffels 2002). To combat a systems crisis, a breakdown is required to pave the way for a transition in the system.

Transitions and system innovations

When we consider societal innovation at the level of broad societal themes and challenges, we speak of a societal transformation or transition. A transition is a structural societal change that is the result of economic, cultural, technological, institutional as well as environmental developments, which both influence and strengthen each other (Rotmans et al. 2000). Transitions are structural changes that take quite some time, at least one generation (25–50 years). When looked at in the light of this timeframe, transitions seem to take place along gradual lines. However, in the short term we see a process that moves by fits and starts, in which small shocks and huge waves alternate with and influence each other. This happens because transition periods encompass both rapid and slow changes. It is worth noting here, that the terms 'rapid' and 'slow' are relative notions. Transitions take much time because existing boundaries, barriers and relationships – in short, the existing structures – must first be broken down. Metaphorically speaking, we could represent transitions mechanistically as a complex system of societal cogwheels which act on each other. Each cogwheel has its own dynamics; from the rapidly moving economic cogs to the relatively slow cultural cogs, to the extremely slow ecological cogs. Every now and then these societal cogwheels act on each other in such a manner that they strengthen each other, thereby giving rise to a spiral movement as shown in Figure 1.

This spiral movement is only possible when innovations at various societal domains come together and strengthen each other. A prerequisite for transitions is therefore that innovations take place at the level of societal systems. Put differently, transitions require system innovations. System innovations are organization-transcending innovations that drastically alter the relationship between the companies, organizations and individuals involved in the system. A system is defined here as a coherent system of components which influence each other in a particular direction, for instance an economic sector, a trade sector, a societal domain, or a town or region (Rotmans 2003). The systems level is therefore the overarching level at which individuals, companies and organizations have organized themselves. Innovations further take place within system innovations on a smaller scale, in terms of products, services, processes and projects. In this way, a cascade of innovations can clearly be discerned; transitions arise from a number of congregating system innovations, which in turn result from project, product and process innovations and vice versa.

There are major differences between system innovations and 'standard' innovations; system innovations span a much longer timeframe, are surrounded by great uncertainties, affect a wide range of fields and do not focus primarily on a (latent) market demands, but on the development of public goods and services for which a properly-functioning market is yet to be found. System innovations are sensitive to market and system failures, and consequently focus on combating them (Ministry of Housing, Spatial planning and Environment 2002).

Examples of transitions and system innovations include the following:

- the switch from coal to natural gas as the most important source of energy in the Netherlands in the 1950s and 60s, during which system innovations took place in the area of distribution, house-building, trade and industry and institutional arrangements (Verbong 2000);
- the transition from an industrial economy to a services- and knowledge-intensive economy, with system innovations in a variety of economic sectors, such as the modernization of agriculture, the chemical industry and transport services.
- the demographic transition from a balance between high birth and death rates, to a new balance between low birth and mortality rates, during which system innovations took place in the area of health care, hygiene, behaviour, prosperity and health.

A good, although somewhat atypical example of a transition is that of water management in the Netherlands:

From stemming water to accommodating water

Water management in the Netherlands in the past centuries has been based upon a strategy of pumping-draining-dyking in, which was geared towards combating and keeping water in control. Just when the water problem was thought to be under control, we were confronted with a growing number of unpleasant surprises and calamities. This has led to a change of perspective within the water world: from monitoring and keeping water in check (stemming water) to allowing water more room for manoeuvre (accommodating water), applying a more preventive and anticipatory management style. Water is therefore no longer perceived as simply a technical problem, but rather as a societal issue. Water should therefore have a more leading role in spatial planning processes. The seeds of this change of perspective were sown by a small group of people decades ago,

initially from outside of the water world – from the nature development, landscape conservation and spatial planning sectors – and later from within the water world itself. The fact that this change of perspective worked its way right up to the level of national water policy has multiple causes: (1) a few visionaries rose to strategically important positions within the water world: (2) knowledge born of years of experience and a growing awareness that existing methods of water management are unsustainable; (3) the influence of concepts from landscape and nature conservation policies; (4) increasing environmental awareness – especially with regard to climate change and rising sea levels – and; (5) various calamities, notably flooding in the past decade.

The effective transformation of this change of perspective into transition policy is still in its infancy. Although the change of perspective is partly reflected in various subsequent water policy documents and statements, - especially those addressing the trend towards integral water management- , implementation is still being thwarted by a large number of obstacles and bottlenecks. However, the first practical results are already beginning to be visible in the form of public-private arrangements, the designation of retention areas and the regional usage of potencies of water. Furthermore, experiments have started in the area of sustainable water management at the district level and in the area of sustainable industrial water management. These first experiments are promising, but at the same time, they also reveal the pitfalls and predicaments still facing the practical implementation of transition policy in water management. In other words, it is still premature to speak of a successful water transition, because the point of irreversibility has not yet been attained. But this is nevertheless a good example of a knowledge-oriented transition. For a detailed description of the water transition, see (Van der Brugge, Rotmans, and Loorbach 2005).

Transitions and system innovations are a response to both market and system failures. With reference to market failures, this means the absence of an optimally functioning market system, because the market does not adequately invest in innovation or in R&D. System failures reflect flaws in societal systems; in the *economic system* (such as a weak economic infrastructure and a lack of adequate investment capital), the *political-administrative* system (such as institutional bottlenecks, a lack of innovative arrangements and too powerful or too weak networks), or the *innovation system* (such as a lack of lateral thinking, a fixation on technology and insufficient

adaptability). The scientific literature contains many descriptions of examples of system failures, in the energy and agricultural systems, among others. Jacobsson and Johnson (2000), for example, identified a series of flaws in the international energy system: poorly expressed demand, the dominance of fossil fuels – giving rise to a one-sided energy infrastructure – and a technological mono-culture, weak networks and a shortage of competent actors.

A typology of transitions

So far, the terms 'transition' and 'system innovations' have been delineated with rather coarse strokes of the brush, which gives them an ambiguous connotation. In the diverse literature on transitions, the term is usually not defined, but simply used as an umbrella term for a multiplicity of phenomena. This indicates a need for a clear demarcation of the various types of transitions, as observed by Berkhout (Berkhout, Smith, and Stirling 2003) amongst others, who has rightly acknowledged that there is a need for a more precise delineation of the vast field of transitions. We have therefore ventured to draw up a typology of transitions, based on initial efforts made by others in the literature. This has not been motivated by a desire to pretend to have developed the ultimate typology, but by the ambition to once again take the discussion a step further. A useful point of departure for a typology is the distinction Boulding (Boulding 1970) makes between various types transformation processes. He distinguished between: (i) accidental, (ii) deterministic, (iii) evolutionary, (iv) dialectic and (v) teleological or target-oriented transitions.

An example of a coincidental or accidental transition is the change in sexual behaviour, which follows the discovery of Aids. An example of a deterministic transition is the demographic transition, from high birth and mortality rates to low birth and mortality rates, characterized by urbanization and aging, as a result of a social modernization process with changes in the area of lifestyle, education, health care, hygiene, female participation in the work process, economic development and family planning. An example of an evolutionary transition – characterized by the evolutionary mechanism of mutation and selection – is the switch from an industrial to a service-oriented economy, whereby numerous companies and efficient practices, customs and products are selected, fed by the urge for innovation. It is difficult to cite an example of a dialectic transition, but revolutions could be considered possible examples. And finally, teleological or target-oriented transitions are inspired by a preconceived goal: among these are infrastructural transitions, such as the switch from coal to natural gas for home-heating, whereby the ultimate objective was reasonably clear, and towards which the national government and private parties could effectively work (Verbong 2000).

Berkhout *cum suis* (Berkhout, Smith, and Stirling 2003) distinguish various contexts for transitions, in which two dimensions are identified: the availability of resources and the degree of coordination. That gives rise to the following classification: (i) emergent transitions, analogous to evolutionary transitions, without much coordination among actors, for instance, around the introduction of genetic modification in the food and pharmaceutical sector; (ii) targeted transitions, analogous to teleological transitions with a great deal of coordination of actors, as was the case in the nuclear energy sector.

From these efforts, we have deduced the following dimensions for a transition typology. The first dimension involves teleological versus emergent. The second reflects the degree of coordination, from high to low and the third dimension corresponds to the level of aggregation (high versus low). Using the metaphor of a cartwheel (roughly translated according to Philip van Notten's scenario cartwheel (Van Notten 2005)), we can identify eight different types transitions: from emergent, hardly coordinated and highly aggregated transitions, such as the internet revolution, to teleological, highly coordinated and slightly aggregated transitions, such as the transition from coal to gas. This is shown in Figure 2.

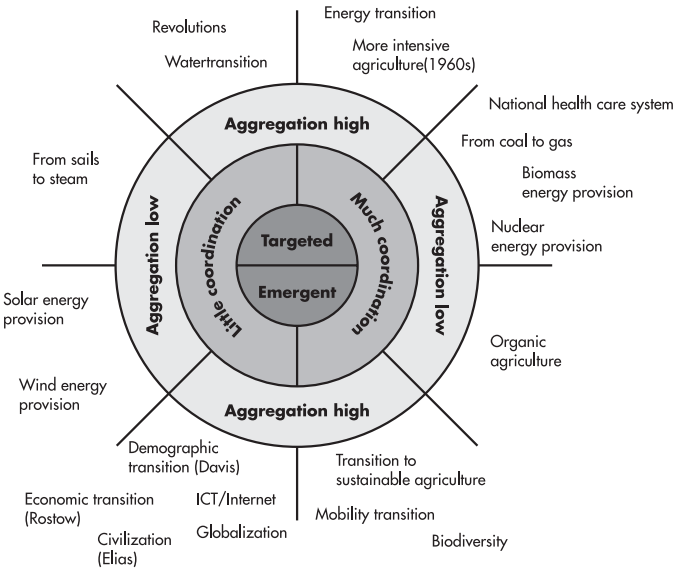

Figure 2 A typology of transitions

It is striking that current transitions (energy, agriculture, mobility and biodiversity), which are part of Dutch transition policies, differ in certain key dimensions, according to this typology. They are similar with respect to the degree of coordination (high, with much interference from the government) and the level of aggregation (high, i.e. geared toward an integral approach at the domain or sector level), but not with regard to the degree of specific focus. The energy transition appears to be more targeted than the mobility transition and also more targeted than the agricultural transition. We also notice the atypical character of the water transition, which itself is by far less coordinated than the energy or agricultural transition. Equally striking is the fact that most of the transitions that are – or were – the subject of research are less aggregated, barely coordinated emergent transitions. One can argue about the typology as well as the allocation of the transitions to the various dimensions. And, of course, the demarcation between the various types of transitions is not always easy to define, because there is an overlap between them. Nonetheless, this typology is a useful tool, which makes it possible to compare the various types of transition, and also to refine and make the often general discussions on transitions more specific.

Towards a new paradigm for the "interdiscipline" transition science

Transitions and system innovations are complex phenomena that cannot be entirely investigated from one scientific discipline. That's why a multidisciplinary and interdisciplinary approach to analysing, describing and explaining transitions and system innovations is necessary. But even a purely scientific approach does not suffice; a trans-disciplinary approach is also needed, with the input of societal knowledge and expertise. Moreover, this exchange of knowledge between scientists and societal actors does not follow a linear path, but rather forms a societal process of co-production between the parties involved. Because of this, research into transitions constitutes a membrane with only thin dividing lines between fundamental/theoretical work, practice-oriented research and practical experiments. This is innovative research, aimed at exploring the connections between scientific disciplines and between scientific and societal knowledge as well as at devising new, discipline-transcending concepts. The scientific points of departure for this new 'interdiscipline' – transition science – are briefly discussed below.

Multi-, inter- and transdisciplinarity

These concepts cover a broad spectrum of cooperative modalities for research into transitions, with gradations in the intensity of the cooperation between disciplines and the degree of integration of knowledge. Multi-disciplinarity refers to a passive form of cooperation in which the exchange of disciplinary knowledge occupies a central position and not so much the integration of knowledge and the bridging of paradigms. In the case of interdisciplinarity on the other hand, there is interactive cooperation between scientific disciplines, which is an attempt to bridge individual paradigms in order to attain a certain degree of integration of knowledge, with the aim of collectively solving problems. Trans-disciplinarity, finally, requires working across disciplines and the input of knowledge and expertise of non-scientists. The societal actors involved do not operate within a scientific context, but make useful contributions to the final production of knowledge. In the intended research into transitions, the emphasis is on inter- and trans-disciplinarity, whereby paradigmatic bridging takes place.

Non-linear knowledge development

Non-linear knowledge development refers to a process in which knowledge is developed by scientists in co-production with societal actors. The underlying rationale is that a synthesis can take place only through frequent interactions – and sometimes confrontations – between theoretical knowledge, practical knowledge and practical experience, as a result of which innovation can penetrate and take root at the societal system level. In this context, both knowledge institutes and societal institutions become co-innovators in new, knowledge-generating networks, which is in line with the switch from mode-1 to mode-2 scholarship postulated by Gibbons (Gibbons et al. 1994). Whereas the orientation in mode-1 is strictly academic and mono-disciplinary and scientists operate in homogenous networks, the orientation in mode-2 is also academic, but includes multidisciplinary and interdisciplinary input as well, and it is also societal from a trans-disciplinary point of view, with scientists being actively involved in heterogeneous networks. In mode-1, scientists are mainly responsible for their accomplishments in the scientific arena where they belong. In mode-2 however, scientists are also active in other arenas, which also makes them responsible and accountable for other activities, such as their role in societal change processes. This is in parallel with the new assessment mechanism for companies which increasingly assesses companies on their responsibility towards people and planet, as well as profit (http://www.maatschappelijkverantwoordondernemen.net/); (Cramer 2002).

Social learning as a point of departure

Social learning constitutes an important point of departure for research into transitions. It does not really refer to learning in the sense of the transfer of knowledge, but more to learning in terms of developing in interaction with others another viewpoint of reality. That social learning process contains cognitive elements, such as notions on the complexity of reality, exploring various outlooks on complex reality, as well as perceptions of one's own abilities and of the influence of the social surroundings (Leeuwis 2003; Social Learning Group 2001). Social learning is crucial to transition processes, because neither the definition of a problem nor the direction of the solution is unequivocally known à priori. The distinguishing feature of transition processes is that they are common searching and learning processes, where participants jointly try to find a shared problem perception and directions for sustainable solutions. Here, the process of 'reframing' – which ultimately leads to a change of perspective – is a key requirement for realising a transition. A change in perspective cannot be forced, but comes about as a result of a growing understanding and practical experience, in which social learning can be an important element.

Complexity and uncertainty as a point of departure

Complexity and uncertainty represent a clear point of departure for research into transitions. The reasons for transitions and system innovations and their consequences are not unequivocal. They are the result of various causes and consequences that repeatedly and reciprocally act on each other. Put differently, transition patterns have various determinants such as behaviour, culture, technology, economy, institutions, environment and policy, which repeatedly influence each other reciprocally and which therefore cannot be studied in isolation, but only collectively. This is known as co-evolution; the causal factors co-evolve and can jointly lead to an irreversible change. The concept of co-evolution therefore plays an important role in research into transitions (Geels 2002; Rotmans et al. 2004).

Uncertainty also provides a useful guideline in research into transition issues. Uncertainties are generally still seen as problems instead of facts. Because supposed certainties are often nothing more than sham certainties in reality, they bounce back like a boomerang in the form of unpleasant surprises and discontinuities, which are in fact expressions of complexity (Van Notten 2005). Rather than attempting to reduce uncertainties, research into transitions seeks to map out the nature and types of uncertainties, through learning and experimenting. The typology of uncertainties as developed by Van Asselt (Van Asselt 2000; Van Asselt and Rotmans 2002) can be helpful in determining which uncertainties are structural – and therefore difficult to influence – and which can be reduced. This ties in with the post-normal scientific approach of Funtowicz and Ravetz (Funtowicz and Ravetz 1990; Funtowicz and Ravetz 1994). They stress that the subjective assessment of uncertainties should not be left to scientists, but that societal actors (stakeholders) should also be involved.

Sustainability as a normative framework

Sustainable development is an intrinsically normative, subjective and ambiguous concept and is therefore difficult to operationalize (Rotmans, 2003). One option is to make a synthesis of a theoretical approach and a participatory process approach. The theoretical approach is built on the concept of strategic stock management (Grosskurth and Rotmans, 2005). The capital in any given geographical area can be determined by assessing the dynamic development of the available stocks. This assessment is, however, subjective and therefore has to take place in a participatory process with societal actors. In this way, a sustainability balance can be drawn up, which makes the tensions on the one hand, and the coherence between people, prosperity and the

surroundings, on the other hand, transparent and visible in a controllable manner (ICIS, 1999; Telos, 2002).

In relation to transitions, sustainable development can be used as a normative, directive framework. This sets before us the major challenge of initiating transitions or stimulating those that are already underway in the direction of a (more) sustainable society. Sustainability therefore touches on the key values in our lives, proceeding from the connection between the "head" and "heart", which evolves around the quality of life, solidarity with those who are worse off than us and a relationship of equality between man and nature. An emerging discipline that preoccupies itself with this is the science of sustainability – or sustainability science (Kates et al. 2001; Clark, Crutzen and Schellnhuber, 2005). This has a long way to go before it becomes a discipline of its own right; it is rather an active area in which science, practice and visions of the North and South meet, with contributions from the entire spectrum of the natural and social sciences and economics (Martens 2005).

The above paradigmatic points of departure can constitute a basis for the yet-to-be developed 'science of transition'. This new field is both interdisciplinary and theoretically oriented, but also practice-based. When integrating the various research principles along coherent, consistent and transparent lines, the field of Integrated Assessment can play a key role (Rotmans 2005).

Conceptual framework for research into transitions

In the previous chapters we have seen that research into transitions and system innovations is still in the pre-paradigmatic phase. In order to move this research forward, we need a conceptual framework. Up to now the scientific literature about transitions and system innovations has not discussed conceptual frameworks, as has been noted by Weber (Weber 1997), (Berkhout, Smith, and Stirling 2003), (Geels 2002) and (Rotmans et al. 2004). So in this chapter we attempt to create a conceptual framework, consisting of four interlinked conceptual building blocks, which in turn provide an outline of a transition theory in its early stages of development. This embryonic transition theory will be further developed by exploring and (partly) by reviewing four discrete but connected transition hypotheses and the underlying transition concepts:

Hypothesis I

The dynamics of transitions in time can be described as alternating phases of relatively fast and slow dynamics, which together form a strongly non-linear pattern where there is a shift from one dynamic state of equilibrium to the other.

The hypothesis is that the dynamics of transitions in time can be described by the multi-phase concept that forms a regulatory framework concerning direction, speed and size of the transition (Rotmans et al. 2000). In this regulatory framework we can distinguish four different phases: (i) *the pre-development phase* from dynamic state of equilibrium in which the status quo of the system changes in the background, but these changes are not visible; (ii) *the take-off phase*, the actual point of ignition after which the process of structural change picks up momentum; (iii) *the acceleration phase* in which structural changes become visible; (iv) *the stabilization phase* where a new dynamic state of equilibrium is achieved (Rotmans et al. 2000).

In terms of system dynamics during the pre-development and stabilization phases there is a regime of negative feedback that dampens down the system response (i.e. this phase is relatively orderly and stable). In contrast, the take-off and acceleration phases are dominated by positive feedback that amplifies the response of the system, causing a relatively short period of chaos and instability.

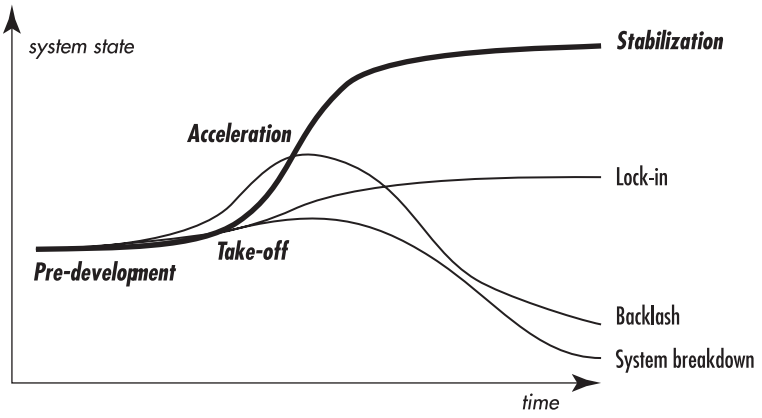

Figure 3 The different phases of a transition and different transition paths

The manifestation of alternating phases is the so-called S-curve: an aggregation of underlying curves. However, other manifestations in time are also possible, such as the illustration in Figure 3. The S-curve represents an 'ideal' transition, in which the system adjusts itself successfully to the changing internal and external circumstances, while achieving a higher order of organization and complexity. However, non-ideal or even reverse transitions are possible. For example by increasing path dependence: choices made in the past exclude different opportunities now, e.g. by ingrained behaviour or ideas that get stuck so that a lock-in situation emerges. The only way to clear such a lock-in situation and turn it into a transition is by applying force from outside the system. Choices made early on can also reduce the necessary diversity, causing a backlash. Insufficient knowledge, support or embedding in the system can cause so much resistance that the system innovation path will be blocked. And finally an 'overshoot collapse' situation may occur. In this case a reverse transition takes place and the system collapses and eventually dies.

The smooth curves are deceptive: viewed for a longer period of one to two generations, transitions appear to take place gradually, but in the short term transitions display changeable dynamics, with many sudden changes and unexpected events. The sequence of phases does not follow a set pattern: the transition is surrounded by great uncertainty and complexity, so the degree of predictability is relatively small. But the transition pattern does imply specific generic patterns such as

path dependency that indicate the future transition path. The purpose of ordering the phases is not to forecast the course of the transition through time, but to create an opportunity to recognise the various phases and as such, to provide some guidelines for achieving a desirable end (in terms of sustainability) and a desirable direction for the transition as a whole.

Hypothesis II

The dynamics of transitions in spatial terms can be described as the interactions between three different functional scale levels: the macro, meso and the micro levels, in which transitions only take place when trends, developments and events on the three scale levels strengthen each other in one and the same direction (when modulation occurs).

The hypothesis is that the dynamics of transitions in spatial terms can be described by the multi-level concept, which forms a regulatory framework concerning (functional) spatial changes of transitions (Geels and Kemp 2000); see Figure 5. This regulatory framework distinguishes three scale levels, where the scale levels are intended as functional scale levels and not spatial or geographical scale levels. The scale levels therefore represent functional relationships between the actors, structures and working practices that are closely interwoven. The higher the scale level the more aggregated the components and the relationships and the slower the dynamics are between these actors, structures and working practices. The scale levels we can distinguish are: *the macro level* where the so-called landscape changes take place; trends with a relatively slow progress and developments with a high autonomous character. At this level we find global trends such as globalization, individualization, changes in the political arena, culture, paradigms and transnational actors such as the UN and the WTO and global agreements such as the Kyoto protocol and GATS. Operating at *the meso level* are regimes, systems of dominant practices, regulations and interests that are shared by groups of actors. At this level there is much resistance to change and innovation, because existing organizations, institutions and networks want to maintain the status quo, i.e. the existing configuration of regulations, working practices and interests. Niches develop at *the micro level* within which non-conformism can develop, such as new initiatives, new techniques and new forms of culture and management. At this level short-term developments can follow each other in rapid succession and then disappear again quickly. The multi-level concept provides a snapshot in time of the transition dynamics at the various scale levels. It shows that the transition dynamics

does not start in one place but at different locations at different scale levels. Only when these opposing dynamics modulate, can a scaling up effect and thus a spiral effect emerge as a necessary condition for achieving a transition. For a specific system, this initially takes place within the meso regime and from there subsequently diverges to the micro and macro levels.

N.B. This conceptualization differs from that of Geels and Kemp (Geels and Kemp 2000), who work with technique, technologies or a technological selection environment as the reference unit, while we work with a societal system as the reference unit.

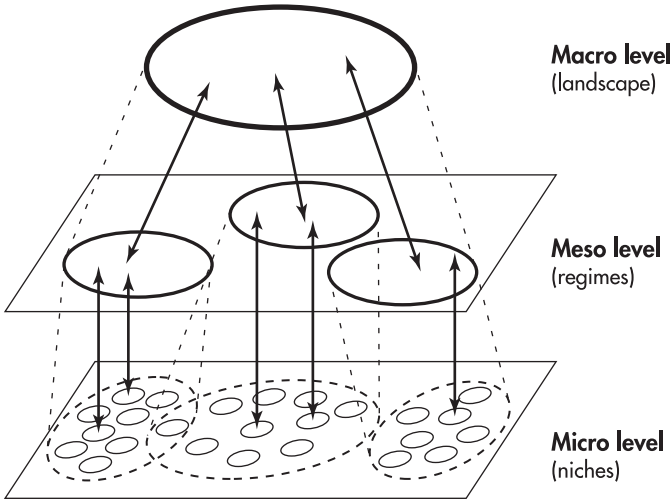

Figure 4 The different scale levels of a transition (Geels and Kemp 2000)

Hypothesis III

The nature of the dynamics of transitions can be described in terms of alternating phases of relative construction and destruction, together with a generic cyclical pattern that results in irreversible changes in a system.

The hypothesis is that the nature of the dynamics of transitions can be described with the multi-change concept, which offers a regulatory framework for the cyclical process of relative construction and destruction in transitions. At the beginning of a cycle, the system in question uses and exploits many sources of aid (inventories) in order to construct a new deep and layered structure. Mutations are continually taking place in terms of variation and selection (of flows), and there is considerable diversity. By increasing the interdependencies between actors, structures and working practices, a dominant regime emerges. The system becomes rigid (reduced diversity due to selection mechanisms), and static, whereby the system is unable to react flexibly to changes in its surroundings. Fragmented niche regimes arise and as a result they can usually be absorbed by the dominant regime. If niche regimes emerge into a conglomerate, this forms a direct threat to the dominant regime. The deep structure of the system is attacked, which creates a discontinuity. The consequence of this is a palette of possible development paths; see Figure 3. The type of path chosen depends on the type of construction and destruction process: what is constructed or demolished, how quickly does this happen and which mechanisms are responsible. Which actors, regulations or laws, techniques, types of knowledge come or disappear, how quickly does the scaling up mechanism work, and are internal or external forces dominant? If the niche regimes conglomerate quickly and strongly then the deep structure of the system is attacked quickly and directly; there is a relatively abrupt discontinuity. If the conglomeration process develops more slowly, it is called a relatively gradual discontinuity. In both cases, after a relatively short period of instability, this leads to a full takeover of the regime that establishes itself and builds up a new structure. But under different conditions than at the beginning of the transition cycle: new actors, new structures and new working practices, or in other words: people think differently, work differently and focus on other objectives. So not only better and more [= optimization path], but also different [= system innovation path]. If the conglomeration process does not take off properly, for example due to increasing path dependence (lock-in) or by choices made too early (backlash), then necessary adjustments to the surroundings (regime-transformation) can only be made by external forces. This requires a great deal of energy, resources and actors and is by no

means 'ideal' for the system. If external forcing does not help, then an 'overshoot collapse' situation occurs, causing the system to collapse, leading to a final situation that is not desirable when compared to the 'ideal' transition.

Hypothesis IV

Transitions cannot be directed in the sense of command and control, but they can be influenced. Especially the direction and speed of a transition can be influenced through co-evolutionary steering

The hypothesis is that the steering of transitions can best be described by using the transition management concept. In the context of societal transitions, the term 'transition management' was used for the first time in a background study for the 4th National Environmental Policy Plan, in which it was finally used as "leitmotiv" (Rotmans et al. 2000). Transition management is a new management concept that assumes complexity and uncertainty and is sometimes also known as 'co-evolutionary management': adjust, adapt, and influence (Rotmans 2003). Transition management concentrates on influencing persistent societal problems. The assumption is that there is not necessarily full control and management of these problems, as in classical management, but more the organization of a joint searching and learning process, focused on long-term sustainable solutions. Transition management is not directly focused on a solution, but is explorative and design-oriented. Transition management experiments with various relevant aspects of a range of management forms and attempts to integrate and combine the accompanying instruments. The experiments mainly relate to the integration of short and long-term processes, different scale levels, people from various domains, perceptions of the problem by diverse actors, a wide range of possible solutions, a variety of learning processes and different types of instruments. The integration of aspects of diverging management forms results in a new management paradigm that takes account of complexity and uncertainty in time, space and domain. The essence of transition management is that it focuses on the content as well as the process. This will be discussed in greater detail below.

The envisaged research into transitions within the Knowledge Network on System Innovations and Transitions (KSI) is designed to explore the research hypotheses and underlying transition concepts mentioned above. The hypotheses and concepts have not yet been finalized and these will be further developed and adjusted as part of the explorative research. We should also note that they cannot be fully tested – in the light

of the complexity and uncertainty sketched – but can be only reviewed partially and relatively. This review will be carried out by a combination of 'pattern matching' (comparison of empirical transition patterns with theoretical transition patterns) and 'process tracing' (historical reconstruction of processes and events or construction of future events) (Rotmans et al. 2004). The transition concepts to be studied in more depth form the building blocks of the embryonic transition theory. This requires the formulation of fundamental axioms for the various dimensions of transitions [generic rules for transitions concerning time, space, nature, management]. Empirical review of these theoretical transition axioms will lead to a further improvement and deepening of the existing transition concepts and vice versa. The following repertoire of methodologies will be applied to the research into transitions: *theory development* through fundamental theoretical research, *theory review* by empirical case-oriented research and *comparative analysis* (comparison of transition patterns in various domains, countries or regions).

(Multi and inter)disciplinary foundations for research into transitions

The intended research, which is to be carried out within the Knowledge Centre for Sustainable System Innovations and Transitions and Drift (Dutch Research Institute for Transitions), will concentrate on three main questions:

(i) how and where do transitions emerge?
(ii) can we recognise, monitor and project them at an early stage?
(iii) and how can we manage (influence) transitions, using which mechanisms and instruments?

Research into these issues, which is based on the new research paradigm we sketched earlier, includes an analytical as well as a process-oriented participative component, which we call 'beta-gamma research'. The analytical component of research into transitions focuses on tracing, recognizing and measuring transition patterns. Not in the classical, deterministic sense, but in the co-evolutionary sense, making use of recent insights derived from complexity theory. The process component of research into transitions concerns steering of transition processes, using the focused influence of actors at various scale levels, based on insights gained by exercising new forms of governance. As a link between the formalized, deductive abstractions of complexity theory and the inductive, often empirically developed management concepts of governance, we use knowledge of sociological fields that deal with social systems. This approach focuses on the strong interaction between actors, structures and practices and the related complexity of managing social systems.

I. Complexity theory

Complexity theory, otherwise known as complex systems theory, continues to embroider on the general systems theory that Von Bertalanffy (Von Bertalanffy 1968) published in the 1930s. With the establishment of the Santa Fé institute in New Mexico in the US in the early 1980s a new research movement emerged, which laid the basis for complex systems theory (Holland 1995; Kauffman 1995). This new research, which is currently attracting a great deal of attention, has many applications: in biology (Kauffman 1995), economics (Arthur, Durlauf, and Lane 1997), ecology (Gunderson and Holling 2002), public administration (Kickert 1991; Teisman 1992) and policy analysis

(Geldof 2002; Rotmans 2003). Primary focus is on complex, adaptive systems, in other words those systems with the following characteristics: (i) they are open, that is they interact with their surroundings; (ii) they consist of components that are linked via their mutual interactions; (iii) they contain positive and negative feedback loops with an amplifying or damping effect of the system *response*, respectively; (iv) their behaviour is strongly non-linear, they are nested and encompass various levels of aggregation; (v) there is a variety of components and interactions between components; (vi) there is emergence, in other words patterns emerge 'spontaneously' as a result of interaction between components; (vii) they have various attractors, i.e. a variety of preferred states (Krohn, Küppers, and Novotny 1990) in which direction the system could move of its own accord; and (viii) the system is able to react to and adjust itself to changes in its environment. Essentially complex, adaptive systems can be defined by the following key characteristics: *co-evolution, emergence* and *self-organization*. Co-evolution indicates that that a complex, adaptive system co-evolves with its environment (which in turn consists of complex, adaptive systems), where both competition and cooperation have a role to play. Emergence is the 'spontaneous' development of patterns in the system from within and self-organization is the ability to develop a new system structure as a result of the system's internal constitution and not as a result of external management (Prigogine and Stengers 1984).

The dynamics of complex, adaptive systems

A complex, adaptive system is in a certain state of dynamic equilibrium, where there is apparently little change, but on closer examination there is a constant stream of minor mutations taking place (variation and selection) in the structure of the system. This develops itself in the direction of a specific attractor whereby a dominant regime emerges: an interlinked entity of actors, structures and working practices. The fundamental configuration of the system has a relatively stable structure and order: there is a dynamic equilibrium. For a certain period of time the state of equilibrium offers certain advantages to the system: specific objectives can be achieved, tasks can be carried out and consistency can be built up. These periods of equilibrium therefore last for a relatively long time. However, after a while the system becomes out of sync with its surroundings and all manner of tensions are the result. Internal and external factors contribute to this 'mismatch'. New internal structures emerge which threaten and can eventually destroy the existing deep structure. On the other hand sudden external changes can occur, such as surprises, but gradual developments also occur, such as specific policy or developments in the market. *These internal and external changes create the climate for structural and radical change, but do not actually cause change to take place.*

The change itself is caused by a small core (nucleus) of newcomers who are able to erode the existing deep structure and ultimately dismantle and overthrow it. Newcomers have not yet been moulded by the existing equilibrium and are therefore able to break though it, but for this they need to be shielded in a protected environment, i.e. in a nucleus. It works as follows. The system is approaching a critical point – at the intersection of two attractors – that leads to a relatively short period of instability and chaos. The system reorganizes itself, creates a new regime in a renewed structure and develops itself towards a new attractor on the way to a new dynamic equilibrium and the cycle begins again, with a higher degree of complexity.

Alternatively, the system is unable to react adequately to the radical internal and external changes, cannot renew itself, follows a sub-optimal path and eventually dies out. In this way relatively long periods of equilibrium, order and stability are interspersed with relatively short periods of instability and chaos. There are therefore periods when the system behaves in a relatively orderly manner and, to a limited extent, is predictable. However, there are also periods in which chaos rules and the behaviour of the system is quite unpredictable. In contrast to the assumptions derived from the classical theory of evolution, this process is not characterized by small, gradual developments, but by drastic, sudden and radical changes, also known as 'punctuated equilibria' (Gersick 1991; Gould and Eldredge 1977). Evolutionary economics can be a useful supplement to complexity theory when one is analysing the complexity of transition patterns, particularly when describing the transformation processes at the micro level (Bergh et al. 2005).

Transition dynamics are in fact a special case of this complex systems dynamics. In a transition the complex, adaptive system is successfully adjusted to changed internal and external circumstances and the system thus arrives at a higher order of organization and complexity. This ideal innovation path leads to a new system level with an optimal order and structure. However, this is more the exception than the rule: in almost all cases the system gets stuck somewhere; it follows a sub-optimal path, digs itself in even deeper whereby it eventually collapses and dies (Rotmans, Loorbach, and van der Brugge 2005). This is not surprising, because a transition pattern encompasses a far-reaching process of innovation, with all the associated risks and, in a certain sense it follows the most dangerous route.

Steering of complex, adaptive systems

What does complexity as described above mean in terms of steering? It means that we do not view complexity as a problem or obstacle, but rather as a means of leverage for steering. Steering – in the context of complexity theory – means transforming a complex, adaptive system from one state to another. Then adaptive steering means directing while the structure of a system is changing, while anticipative steering means directing while taking the possible future behaviour of the system into account. Greater insight into the dynamics of a complex, adaptive system leads to improved insight into the feasibility of directing it. In other words: application of complexity theory can result in a collection of basic principles or guidelines that can be used to direct complex, adaptive systems. It is a misconception to assume that this would result in a deterministic collection of rules for management. Reflexivity is inbuilt with respect to the assumptions presumed as well as the possible effects of such a form of direction. *This results in an understanding of the limitations of and scope for the steering (management) of complex, adaptive systems and at the same time provides insight into the opportunities and conditions under which it is possible to direct such systems.*

A Dutch public administration expert (Kickert 1991) has drawn lessons for management of complex, adaptive systems, even though these were relatively abstract and fragmented. In the meantime, complexity theory has evolved further (though the theory is still far from maturity) and more empirical knowledge has been gained from practical experience with the management of complexity (Geldof 2002; Rotmans 2003). Based on theoretical knowledge and practical experience with complexity theory, we present a number of guidelines for steering below. These guidelines are partly descriptive, in the sense of basic principles and partly prescriptive in terms of rules for steering.

- *The status of the system determines the way it is managed*. The dynamics of the system creates feasible and non-feasible means for steering: this implies that content and process are inseparable. Process management on its own is not sufficient – insight into how the system works is an essential precondition for effective management.

- *Steering at the system level is essential*. Unintended side-effects and adverse boomerang effects can only be recognized and predicted at the system level, incidentally without excluding surprises as a result of adjustments. This implies adjustments at various (functional) scale levels. A complex, adaptive system cannot be directed from just one scale level; it has too many emergent properties: properties that are (still) hidden at a higher (or lower) scale level but are already beginning to emerge at a lower (or higher) scale level.
- *Objectives should be flexible and adjustable at the system level*. The complexity of the system is at odds with the formulation of specific objectives. With flexible evolving objectives one is in a better position to react to changes from inside and outside the system. While being directed the structure and order of the system are also changing, and so the objectives set should change too.
- *The timing of the intervention is crucial*. The nearer one is to the critical point in the system, i.e. on the dividing line between two attractors, the more effective the intervention. Immediate and effective intervention is possible in both desirable and undesirable crisis situations. Crises are not necessarily negative and they can create room for manoeuvre towards a favourable attractor.
- *Newcomers can effectively create a new regime in a protected environment*. Newcomers are not yet dependent on the existing regime and they can attack it without any direct consequences. But because this takes time and because pressure increases as time elapses, a certain degree of protection is needed (a nucleus). Newcomers form niche regimes at the micro level that can later conglomerate into a new regime at the meso level.
- *Managing a complex, adaptive system means using disequilibria rather than equilibria*. In the long term an equilibrium will lead to stagnation and will in fact hinder innovation. Non-equilibrium means instability and chaos, which forms an important impetus for fundamental change. The relatively short periods of non-equilibrium therefore offer opportunities to direct the system in a desirable direction (towards a new attractor).

On the one hand the challenge lies in a theoretical deepening of these steering guidelines and on the other hand in their application in societal systems, particularly in practical situations. The strength of complexity theory is that it uses relatively simple analytical principles to describe and explain patterns in time, space and functionality. A weakness is the homology that is assumed between abstract mathematical systems and concrete societal systems. This requires a one-to-one transposition that is not

always realistic. Nevertheless, the elegant analytical principles of complexity theory have been applied to ecosystems and societal systems with increasing frequency in the past decade (Allen 2001; Gunderson and Holling 2002; Walker 2004).

II. New forms of governance

Governing societal change in a desirable direction has been the focus for research by public administration and political scientists and other social scientists for many decades. There seems to be an increasing degree of consensus in this hybrid research field that traditional forms of governance are not suitable for societal challenges with a high degree of complexity. Both classical top-down governance by government ('the extent to which social change can be effected by government policies') as well as the liberal free market approach ('the extent to which social change can be brought about by market forces') are now outmoded as effective management mechanisms to generate sustainable solutions at societal level. Many researchers therefore argue for new forms of governance to reduce, or better still, eliminate this lack of direction. The inadequacies of current forms of governance are exposed when we consider government failures and the need for new arrangements to give direction (see authors such as (Mayntz 1993), (March and Olson 1995), (Fox and Miller 1996), (Scharpf 1999), (Hooghe and Marks 2001), (Teisman 2005) and (Pierre and Peters 2000)). This failure is also emphasized in the light of increased societal complexity and the complex, unstructured nature of policy making processes (see (Hisschemöller 1993), (Kooiman 1993), (Kickert, Klijn, and Koppenjan 1997), (Sabatier and Jenkins-Smith 1999), (Lindblom and Woodhouse 1993)). All the researchers mentioned above point out the impracticability of classical top-down governance, but at the same time they indicate that there is still a need to direct complex societal dynamics. Although it is not easy to generalize, the new forms of governance they discuss are characterized by a number of central, and in some areas, common assumptions.

First of all, the *network approach*. Our society has become a complex network society (Castells 1996). Societal actors create formal and informal networks, because they have the same vested interests and they are striving towards the same objectives, something that they cannot do well without each other and which they can better achieve jointly than individually. Network steering: joint management by all interested parties within a network has become a common phenomenon (Dirven, Rotmans, and Verkaik 2002; Kickert, Klijn, and Koppenjan 1997). Networks do not have a clear hierarchical structure

like institutions and organizations but, after a certain time, they can silt up and develop into institutions or organizations with the same rigid structures (Dijk 2001). Cörvers (Cörvers 2001) also noticed that in network projects problems often arose in agreeing agendas (mutual agreement of different agendas) and there were practical problems (in practice it often transpired that the network objectives were in fact government objectives).

The *interactive approach* has also become widely accepted. As a result, governments work more and more interactively, in order to activate networks and to stimulate them by means of carefully targeted incentives. Besides the government, other societal actors also attempt to direct a process where they have mutual influence (Bruin 1998; Dirven, Rotmans, and Verkaik 2002). Efficient and effective interaction between the most important directing societal actors has also become an essential condition for the new forms of governance that have emerged in the past decade.

Each form of direction that is focused on societal complexity should also take into account the pluriformity of interests, values and prospects of a wide range of societal parties. This demands a *pluralistic approach* that assumes the basic principle of plurality of interests and values for coordinated action in such a way that the compliance of all actors involved is achieved (Eising and Kohler-Koch 1999; Grin 2004). This is an attempt to clarify the different perspectives (systems of norms, values, motives and perceptions) of the parties involved (stakeholders) (Rotmans 1997). Agreement can only be reached, when there is a sufficient degree of convergence of the parties' perspectives on a specific solution for a multi-actor issue.

Societal dynamics is characterized by the interference of developments and trends at different scale levels, spatial, temporal and functional. A mono-level perspective of governance is thus inadequate to direct societal or policy complexity. A *multi-level approach* is therefore essential to manage the network as effectively as possible at various scale levels. Unfortunately there are hardly any governance concepts that take the interactions between governance processes at various scale levels into account, in particular the interactions between the functional scale levels themselves (Rotmans and Rothman 2003). A poignant example of this is environmental policy, which is becoming more European in nature, with all manner of problematic consequences for the Netherlands. Another example concerns developments within international water policy. These focus increasingly on river basins that traverse countries and regions, and

in which the functional (institutional) scale level is becoming even more important. However, there are currently no proper governance concepts at the river basin level.

Learning about uncertainty and complexity has become an important part of societal steering processes, because the uncertainty and the increasing complexity in governance processes are often of a structural nature. This is not so much cognitive learning, but social learning – developing interaction with others from an alternative perspective on reality (Leeuwis 2003; Social Learning Group 2001); see section IV. Here, the influence of the social context on learning is central, both in the encouraging and in the impeding sense (Loeber 2004). It is very important here to gain insight into the perceptions of others who are learning at the same time. Only when we comprehend each others' ideas, motives and vision and we develop a better understanding for each other, will we be able to search together and develop a common agenda.

Transition management as a new management concept contains the main characteristics, as mentioned above, of new forms of governance: network management, interactivity, pluralism, multi-level focus and social learning. Transition management is by definition a multi-actor process with participation from government, societal organizations, companies, knowledge institutes and intermediary organizations. Because of this participation at various levels a multi-level network emerges within which different themes are discussed and tackled (Loorbach 2004). Transition management facilitates a range of processes and points them in the same direction with a combination of network steering and self-steering. As such, transition management can be considered as a specific form of multi-level governance (Scharpf 1999), (Hooghe and Marks 2001). The co-evolutionary multi-level perspective is based on the 'advocacy coalition framework' (Sabatier and Jenkins-Smith 1999) and the concept of 'partisan mutual adjustment' (Lindblom and Woodhouse 1993). Various groups with a wide range of interests and ambitions attempt to get their own themes placed on the political agenda. By negotiation, adaptation, co-production and debate, actors change their own vision and redefine their own position and perceive the problem in a different manner.

In addition transition management also has quite some similarities with well established forms of governance. Transition management has some of the characteristics of the governance school of incrementalism (Lindblom 1979). Notably the focus on uncertainty, learning by doing and doing by learning and the organization

of searching process with several solutions. On the other hand there are also major differences: the means of leverage is different, in transition management this is the complex societal system as a whole and not just managing components, as Lindblom's 'disjointed incrementalism' indicates. Transition management does not always imply an incremental path; in the relatively short-term the path can be rather whimsical, a combination of small and large steps which are designed to break down the system and take over the dominant regime. Transition management therefore focuses on radical and structural (irreversible) change, which is certainly not always the case in the incrementalist approach. And finally, the visionary aspect, which Lindblom considered to be rather repugnant (particularly blueprint thinking), but which plays a crucial role in transition management, in a co-evolutionary form. So we see that on the one hand there are clear similarities, but on the other there are considerable differences between transition management and the incrementalist approach.

This applies equally to the comparison between transition management and the school of 'adaptive governance' (Gunderson and Holling 2002; March and Olson 1995). Even here, at first glance there are many similarities, but a closer analysis also reveals many differences. The essence of 'adaptive governance' is a form of plan which is based on the analyses of various types of uncertainty, both structural and non-structural. A strategy is developed which in the short term hardly pays any attention to structural uncertainty, while attempting to reduce structural uncertainty in the long term. This results in a cyclical plan – a combination of short-term steps designed to tackle uncertainty that can be 'managed' and long-term steps designed to tackle structural uncertainty. This can easily lead to 'no regret' strategies, i.e. strategies that will do little damage, irrespective of future scenarios – a kind of low-risk strategy. Conversely, transition management encompasses a portfolio of experiments, and particularly high risk experiments, because a great deal can be learnt from these. In addition transition management is not only adaptive but also anticipating (focused on the long term), which does not necessarily assume a reduction in uncertainty, but rather accepts that structural uncertainty cannot be reduced.

A comparison of transition management with traditional and new forms of governance therefore results in a pluriform impression. We find transition management – described as a form of governance focused on cooperation in which actors from government, the market and civil society participate in a variety of networks – recurring as the basic principle for many new forms of governance which have developed at a

rapid rate during the last 15 years, for example 'multi-level, adaptive, participation, interactive and deliberative governance'. Transition management, which is described as a form of intelligent, long-term planning through small steps based on learning and experimenting, links into the incremental approach and 'adaptive governance'. Actually transition management is a kind of 'perspective incrementalism'.

However, apart from the integration of these governance aspects, transition management also has its own distinguishing characteristics. Firstly, the combination of "visionarity", the very long-term perspective, and sustainability as normative guiding principle is a specific distinguishing aspect compared to other new forms of governance. But more importantly the combination of analytic insight into systems complexity and understanding of the process of governance complexity is new and has resulted in a specific steering framework, what we will discuss in more detail in section VII.

III. Social Theory

A great deal of research has been carried out into societal dynamics within the field of sociology. For research into transitions, social theory offers a useful starting point for analysing societal dynamics. Social systems in relation to societal complexity can form a bridge between system complexity (derived from complexity theory) and steering complexity (derived from new forms of governance). The background reasoning is that transitions are societal processes in which co-evolution between structures, actors and practices takes place. This is derived from the understanding of social theory that societal structure is both the result and means of acting: structure emerges from the (intended and unintended) effects of acting. Once it exists, it contributes to the determination of rules and means for acting of societal actors (Giddens 1984; Grin, Graaf, and Vergragt 2003). In this context transition management can be described in terms of the following three processes: (i) defining sustainable transitions & system innovations by means of a vision development process; (ii) stimulating, searching for connections to and maintaining long-term dynamics; and (iii) dismantling the current regime that gets in the way of the transition (Rotmans et al. 2004).

Giddens (1984) discusses the interactions between structures, actors and practices. In contrast to Luhman, Giddens researches these dynamics more at the agency level than at the systems level. He does consider the dynamics of the regime and with this the

associated structural changes, but he is particularly interested in how practices are a consequence of the interaction between agency and structure. And with this he operates more at the micro level, where structures form the condition for the acting of agency (actors).

The triangle of structures, actors and practices also plays an important role in Luhmann's work (Luhmann 1995). Luhmann assumes an extremely complex, rapidly changing and unmanageable reality. Social systems can bring some coherence in this complexity and based on their structure they contribute a sense of purpose to societal dynamics. Social systems fulfil societal functions: economic, political or legal. They are functionally differentiated (Luhmann 2002): the legal sub-system fulfils judicial functions, the political sub-system political functions, etc.

For Luhmann the structures are the decisive factor for the dynamics of social systems. Structures determine how the actors can act, but the structures themselves are also subject to change, notably through the changes in functions that the structures fulfil. The social systems researched by Luhmann are in his view often (relatively) closed, because they filter the information from the surroundings that is allowed to enter the system, making management from outside all but impossible. Using the approach of a relatively deterministic structure of social systems Luhmann works mainly at the meso level: there is little attention to any change of structures from within due to the dynamic behaviour of the actors. Later Luhmann uses the term 'autopoiese' in his social systems theory, a phenomenon that was discovered by Varela and others (Varela, Maturana, and Uribe 1974). Autopoietic systems create themselves: structures create their own structures in order to survive. Social systems are therefore self-selecting, self-referential and self-creating. In other words, in transition terminology this is how a regime attempts to maintain itself.

In comparison with Luhmann and Giddens, Beck (Beck 1999) considers the triangle of structures, actors and practices mostly from the macro-perspective. He takes global dynamics as his starting point, whereby all manner of surprises and discontinuities creep into social systems that can have a significant influence on the interactions between structures, actors and practices. He points out the hazards of the risk society, where many uncertainties and risks creep into our systems and where we have the inclination to control the 'small' risks and to ignore the 'large' risks.

The heart of the matter is that Giddens, Luhmann and Beck all take societal complexity as their starting point and approach this from various perspectives. There is a striking similarity with complexity theory. Initially Luhmann discusses variation and selection, autopoiese (negative feedback) and self-organization (at a certain level). Giddens discusses emergence and co-evolution, while Beck concentrates particularly on uncertainties, discontinuities and co-evolution. Of course it is not possible to transpose the concepts of complexity on a one-to-one basis on social systems. For this, notions such as power, (un)willingness and emotion play too important a role.

Combined insights derived from complexity theory, governance and social theory

It is interesting to draw parallels between insights derived from complexity theory, new forms of governance and social theory. We highlight here only some of the parallels that immediately spring to mind: (i) societal change is a complex and uncertain process, but does actually show systematic patterns: governance of societal change should therefore start from complexity and uncertainty; (ii) major changes originate partly as a result of interference of interventions at various scale levels: not top-down or bottom-up but as a combination of these approaches; (iii) the regime paradox: the regime as crucial link and obstruction for societal innovation, while the regime itself attempts to stimulate this innovation; (iv) the transformation of a regime can take place most effectively through small cores that offer protection to people who are not directly dependent on that regime (transition arenas or nuclei), in combination with sudden external changes; (v) steering from 'outside' a system is not effective: actors, structures and practices adapt and anticipate in such a way that these should also be directed from 'inside'.

Transition management: the steering framework

Transition management is designed to encourage and stimulate societal innovation towards a sustainable society. This is based on the realization that this cannot be done by force or in a top-down manner, but requires a subtle co-evolutionary approach, by means of a visionary process of agenda building, learning, instrumenting and experimenting. The underlying new steering paradigm proceeds from the following assumptions:

- Societal change takes place in sudden steps and in a strongly non-linear manner and by definition is full of surprises and discontinuities.
- Complexity and uncertainty are not problems or obstacles, but are actually a means of leverage for steering of societal change.
- Steering of societal change is a reflexive process of searching, learning and experimenting.
- Everyone directs, being fully aware of the opportunities as well as the restrictions and limitations of directing.
- Society can not fully be constructed by government but is partly and shared "makable".
- It is an illusion to think that the process of societal change can be controlled: the most feasible form of control is coordination and influence.

The transition management concept often invokes the association of control. However, this is a misconception. The starting point for transition management is in fact complexity and uncertainty and it therefore assumes a limited degree of steering of societal dynamics. We have attempted to translate this basic assumption into a limited number of rules of thumb (Rotmans, Kemp, and van Asselt 2001; Rotmans et al. 2000):

- integral policy (multi-domain);
- multi-actor approach;
- multi-level coordination;
- long-term thinking as a framework of considerations for short-term actions;
- steering of learning processes and experimenting;
- maintaining a range of options open within the defined direction for a relatively long time.

The task here is to translate these relatively abstract steering rules into a practical steering framework. We have attempted this by designating transition management as a cyclical process of development phases at various scale levels. The main instrument of transition management is the transition arena: a legitimate experimental space permitted by regular policy in which the actors involved use social learning processes to acquire new knowledge and understanding that leads to a new perspective on a transition issue. This new perspective manifests itself in the form of a shared perception of a problem, a long-term orientation on the future with joint objectives, a common agenda and strategic actions and experiments. By actively involving a range of actors at various levels in different phases a form of network steering can be applied in the transition arena that, at the same time, creates room for manoeuvre for self-steering and self-organization within the limits set.

The cycle of transition management consists of the following components (which can differ in weight per cycle) (Loorbach 2002; Loorbach and Rotmans 2005; Rotmans 2003): (i) structure the problem in question and establish & organize the transition arena; (ii) develop a transition agenda, a vision of sustainability development and derive the necessary transition paths; (iii) establish and carry out transition experiments and mobilize the resulting transition networks; (iv) monitor, evaluate and learn lessons from the transition experiments and, based on these, make adjustments in the vision, agenda and coalitions. In reality there is no fixed sequence of the steps in transition management as Figure 5 suggests. In practice the transition management activities are carried out partially and completely in sequence, in parallel and in a random sequence.

In the steering framework we can distinguish three levels that continually influence each other: the strategic level (envisioning), the tactical level (negotiating) and the operational level (executing) (Loorbach 2002). Depending on the phase of the process, each level of management can be linked to specific types of actors and instruments. This results in a portfolio of approaches and management instruments that can evolve together with the actual progress of the process. The transition management process starts from a strategic, long-term perspective, making a thorough analysis of both alternative routes. As time progresses, the various routes within transition management will cross and intertwine and will influence and strengthen each other.

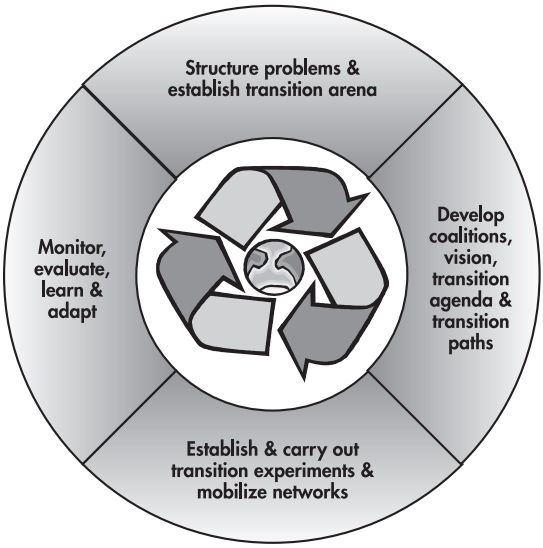

Figure 5 The transition management cycle

Strategic: the transition arena

The transition arena should be seen as a multi-actor innovation network around a specific transition issue, within which various perceptions of the persistent problem and possible directions for solutions can be deliberately confronted with each other and subsequently integrated. The purpose of the transition arena is to bring together a limited number of actors from a range of backgrounds so that they can develop long-term visions of sustainable development. The actors to be involved have their own perception of the transition issue in question from their specific background and perspective. A relatively small number of forerunners from various networks should be involved the transition arena at a *strategic* level. These people participate on a personal basis and not as a representative of their institution or based on their organizational background. They are identified and selected based on their competencies, interests and backgrounds. There should not be too many actors (10 – 15 is sufficient) and they should not all be the same kind of actor. The competencies expected of them and are:
(i) they should be able to consider complex problems at a high level of abstraction; (ii) they should be able to look beyond the limits of their own discipline and background; (iii) they should enjoy a certain level of authority within various networks; (iv) they

should have the ability to establish and explain visions of sustainable development within their own networks; (v) they can think together; (vi) they want to innovate, that is they are open for innovation instead of already having specific solutions in mind. These forerunners do not necessarily need to be experts; they can also be networkers or opinion formers. They should also be prepared to invest time and energy in the process of innovation and to commit themselves to it. And finally, it is important that there are an equal number of forerunners from the societal pentagon: government, companies, non-governmental organizations, knowledge institutes and intermediaries (consulting organizations, project organizations and mediators).

However, the fundamental issue here is not that the existing establishment and interests (such as managers and policy makers) come together within the transition arena, but that niche actors who can operate more or less autonomously are involved. Indeed, a certain representation from the existing regime is necessary, also with an eye to the legitimacy and financing of the process of innovation. But a transition arena is not an administrative platform or a consultative body, but a societal network of innovation. This demands a critical selection of forerunners, not by a 'gatekeeper' who selects who may or may not participate, but by an initiating core group from the societal 'pentagon' that considers matters carefully. The arena process is an open, evolving process of innovation that implies variation and selection: after a certain period of time some people drop out and others join in. Management therefore means creating sufficient space and favourable conditions for the forerunners, such that the envisaged process of innovation begins to take shape. It does not mean gathering together a wide range of bodies around the arena, such as a steering group, a consultation group or advisory board, because that is exactly the recipe for limiting the space for innovation and steering that has just been created.

When such a group of forerunners has been brought together to focus on a certain transition issue, an attempt is made to reach a joint perception of the problem by means of a strongly interactive process. This is far from simple. By deploying a participative integrated systems approach, the complex problem(s) can be structured and made easier to understand (Hisschemöller 1993). The convergence of the various problem perceptions is facilitated from the articulation of diverging perspectives of the actors involved, which in turn will lead to new insights into the nature of the problem(s) and the underlying causal mechanisms. These insights form the prelude to a new way of thinking or a change in perspective, which is a necessary but insufficient pre-

condition to realizing a transition. Based on this new perspective and through discussion and interaction sustainability visions are generated. These visions are particularly qualitative and fairly abstract, but inspiring, challenging and imaginative pictures of the future.

Visions are an important steering instrument for achieving new insights and starting points and therefore a change of attractor. The visions created evolve and are instrumental: the process of envisioning is just as important as the ultimate visions themselves. Envisioning processes – certainly when a number of different actors often with conflicting views are involved – are very labour-intensive and time-consuming, but are crucial to achieving development in the desired direction. This direction, as long as a sufficiently large group of forerunners supports it, provides a focus and creates the constraints which determine the room for manoeuvre within which the future transition activities can take place. Based on the sustainability vision developed, a process can be initiated in which transition paths are developed and a common transition agenda is drawn up. A common transition agenda contains a number of joint objectives, actions points, projects and instruments to realize these objectives. It should be clear which party is responsible for which type of activity, project or instrument that is being developed or applied. Where the sustainability visions and the accompanying final transition-images and transition objectives form the guidelines for the transition agenda which is to be developed, then in turn, the transition agenda itself forms the compass for the forerunners which they can refer to during their search and learning process.

Tactical: the transition agenda

The *new way of thinking or change in perspective*, described by the visions and the accompanying transition-images of the future, should be further translated to and find root within various networks, organizations and institutions. In an expanding transition network stemming from the transition arena this vision is further translated by self-formed coalitions into so-called transition paths: routes to a transition-image via intermediate objectives, which, as they come closer, can be formulated more quantitatively. Different transition paths can lead to a single transition-image and conversely a single transition path can lead to several transition images. In this phase the interests, motives and policy of the various actors involved (non-governmental organizations, companies, governments, knowledge institutes and intermediaries) come out into the open and there will be negotiations about investments, and

individual plans and strategies will be fine-tuned. The actors who should be involved at this stage are those who represent one of the organizations involved and who are willing and able to operate for more than just a short period of time. Within this tactical layer actors should be recruited who, in particular, have sufficient authority and room for manoeuvre within their own organization and who also have insight into the opportunities for their organization to contribute to the envisaged transition process. An important condition for this is that the actors involved have the capacity to 'translate' the transition vision and the consequences of this to the transition agenda of their own organization. When the organizations and networks involved start to adjust their own policy and actions in this way, tensions will arise between the transition arena and the everyday policy agendas. Then the direction will have to be reviewed at a strategic level and if necessary a new arena will have to be established with some of the existing actors, but also with new ones.

The energy transition

In 2001 the Dutch Ministry of Economic Affairs initiated a transition process that is ultimately intended to lead to a sustainable energy supply system in the Netherlands. The Ministry is the initiator, but companies, consumers and non-governmental organizations are also involved. Three themes were chosen: gas, industrial energy efficiency and biomass, because these invariably form part of the scenarios for a sustainable energy supply system in the long term. In addition, the Rijnmond area (greater Rotterdam) was chosen as the 'experimental space'. In consultation with stakeholders, various visions were developed *(where do we want to go?)*, transition paths were formulated (how can we get there?) and transition experiments were drawn up *(how do we get started?)*. In the ultimate vision a sustainable energy system in 2050 is: (a) clean (offers a solution for the climate change problem); (b) affordable (functional and energy-efficient); and (c) secure (dependable, reliable, guaranteed supplies).

This vision for sustainable energy was translated into general transition-images for 2050, strategic ambitions for 2020, and five main routes along which the energy transition policy is defined: (1) efficient and green gas; (2) efficiency in the chain; (3) green raw materials; (4) alternative fuels; and (5) sustainable electricity. For these five main routes 22 transition paths have been worked out in detail, and 16 of them have been authorized.

Within the main route for sustainable electricity, transition paths for 'biomass' and 'wind' have been worked out in detail and within the main route – efficient and green gas – the transition paths 'energy saving in built-up areas', 'micro and mini combined heat and power', 'clean natural gas', 'green gas' and 'glasshouse horticulture savings' have also been detailed. A total of 70 proposals for potential transition experiments have been submitted for these transition paths. See (Dutch Ministry of Economic Affairs 2004), (Dutch Energy Council and Ministry of Housing, Spatial planning and Environment 2004) and www.energietransitie.nl

Operational: implementation

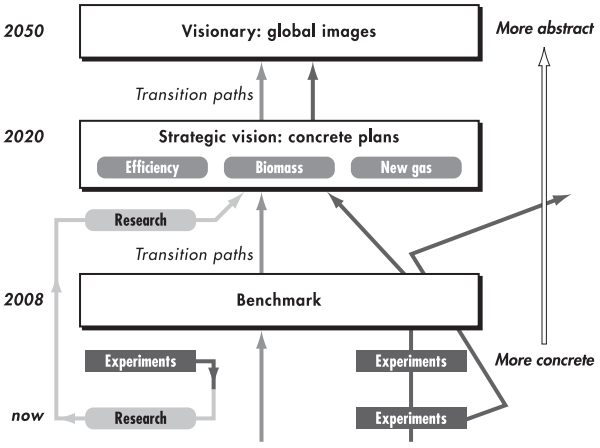

Figure 6 Strategic vision, transition paths, experiments and research (Ministry of Economic Affairs 2004)

A transition requires a regime that thinks and acts differently. The last layer of transition management that we will discuss therefore concerns the operational level within which transition experiments and transition actions are carried out. The practical implementation of a broad new body of thought is quite demanding, because there are very many actors involved who all act from their own perspective, have

conflicting interests, and at the same time are embedded in and are dependent on a broader societal web. There is also a diverse application for transition experiments from the vision and transition paths developed. These may compete, complement each other or investigate various options. Diversity is an important aspect, as long as these experiments at the systems level are in a position to contribute to the envisaged transition.

Transition experiments are practical experiments with a high level of risk (in terms of failure) that can make a potentially large contribution to a transition process. New transition experiments are derived directly from the developed sustainability vision and transition objectives and they fit within the identified transition paths. On the other hand, experiments can be linked to innovation experiments that are already taking place as long as they fit into the context of the transition. Often many experiments are running concurrently, but these have not been set up or carried out systematically, whereby coherence is missing.

Transition experiments in the form of projects also have a tendency to fail, because they are searching and learning processes in which, more often than not, the results are disappointing. Only when an experiment is successful, and has been evaluated, it can be expanded and further developed into a demonstration project, and all this can take a considerable amount of time, approximately 5 to 10 years. Transition experiments are often costly and time consuming, so it is important that, wherever possible, existing infrastructure is used for experiments and that their feasibility is continuously monitored. Efforts here focus on creating a portfolio of related transition experiments that complement and strengthen each other as much as possible, which have a contribution to the sustainability objective that can be scaled up and which are significant and measurable.

In transition experiments, the crux of the matter is innovation in a wide range of areas: these can be technological innovations, but just as easily institutional or cultural innovations. A good example of such a 'test laboratory' could be a 'Vinex' location (new town development in the Netherlands) which will be designed and organized to be sustainable. Innovations can be applied here in all areas including building techniques and technology as well as institutional, social and economic innovations in various combinations. This means that all those directly involved (citizens, architects, project developers, contractors, water and spatial design experts, mobility experts, policy

developers) jointly develop a vision of the design and organization of the new district or neighbourhood. This vision is then translated into a concrete action plan to establish the district or neighbourhood in a sustainable manner, i.e. the combined development of living, working and recreational activities is such that a common and sustainable environment is created. Guiding principles here are not so much efficiency and effectiveness, but issues such as quality of life, quality of the living environment and quality of existence. So these matters are not approached from an economic point of view but from a societal point of view: how do we make a district or neighbourhood fun to be in, lively, safe, clean, colourful, and easy to access, with good facilities and considerable solidarity among residents?

The experiences gained from the transition experiments can lead to changes in the everyday policy of those involved. Would a construction company change its own working practices based on its experiences at the Vinex location? This can speed up and strengthen the spread of innovations, whereby a scaling up effect can arise at the systems level. In transition experiments the main issue is stimulating and developing new forms of cooperation, coalitions, networks and arrangements: parties who hardly ever meet but are now going to work together to look for innovative solutions. The priority here is that they should learn from each other: social learning (learning by doing and doing by learning).

Experimental spaces and test laboratories

Experimental spaces are delimited environments which form a geographical, administrative or functional unit (system). Within these spaces we can identify test laboratories (sub-systems) where practical experiments take place. An example of an experimental space is the "Zuidvleugel" in the Netherlands. This is geographical area in the south-west corner of the Randstad (the conurbation of cities in the west of the Netherlands) that falls within the province of Zuid-Holland. It has approximately 3.5 million inhabitants. The administrative structure in the Zuidvleugel is also ripe for management intervention. There is already an administrative platform, an administrative office and a director. The Zuidvleugel forms a functional unit in terms of a potential network city, within which about 80% of the mobility movements take place and it faces all of the typical problems of the Randstad. So, by defining a transition arena for the Zuidvleugel system, we can also define a transition challenge in terms of the future layout of the area concerning space for living, housing, working,

movement, water, citizen participation, etc. Within this we can establish test laboratories for sub-areas (city regions or rural districts), such as the "Hoekse Waard" or the "Veenweidegebied", the energy experiment 'warmtebedrijf Rotterdam', or the 'light rail / city track' and we can define societal challenges that are derived from the integral problem for the Zuidvleugel. Within these areas we can also establish test laboratories at city, district or neighbourhood level. So we see a cascade of mutually dependent test laboratories emerging and within this, practical experiments can be carried out that converge at the level of the Zuidvleugel. Transition researchers can then analyse, monitor, evaluate and observe these practical experiments within test laboratories and they can also actively participate in them.

Objectives and instruments of transition management

In order to achieve the transition objectives, transition management uses a series of management instruments (transition arena, integrated systems analysis, transition agenda, visions, portfolio of experiments) that only become concrete in the practical situation. Table 1 shows a portfolio of instruments and the required actor competencies in relationship to transition objectives and transition management activities that are subdivided at the various scale levels of the steering framework: strategic, tactical and operational.

Linking content and process

An essential issue in transition management is that the content is explicitly linked to the process itself. In other words: the complexity analysis of the societal system under observation also determines the opportunities for steering and management and the instruments that can be applied using the framework described. This is illustrated in Table 1. Transition management draws together the forerunners (creative minds, strategists and visionaries) in the pre-development phase of transitions for the development of vision and for strategic discussions at a high level of abstraction. For the further practical development of the transition vision and transition paths in arenas of arenas (scaling up through network forming and coalitions), entrepreneurial and innovative actors at the tactical level are involved; project leaders, programme managers, heads of departments and entrepreneurs. The same applies to the operational level; the main parties involved here are inventors, go-getters, practical innovators and practical organizations. During the transition process the vision as well as the programme of measures will become more and more specific, whereby the focus of attention will (have to) shift to 'regime' actors who represent certain interests within

the existing situation. Initially participants will be sought from this group for regime actors geared to innovation, later in the process more conservative regime actors will have to be brought on board.

Level	TM Objectives	TM Actions	TM instruments	Actor competencies
Strategic	Anticipation	Problem perception & structuring	Integrated systems analysis	Systems thinking, Abstract capacity
	Coordination	Exchange of perspectives, agenda development	Transition arena, Transition agenda	Communication skills, Strategic insight
	Future orientation	Vision forming	Scenario development, Transition images	Imaginative capacity, Creativity
Tactical	Variation	Stimulating	Transition agenda, Transition paths	Co-productive thinking
	Selection	Analysis & Negotiation	Transition monitoring, Transition evaluation, Innovation networks	Analytic ability & Negotiation skills
	Networks	Forming coalitions, Imbedding in networks & institutions	Arenas of arenas, Innovation networks	Communication and consensus building
Operational	Development	Experimenting	Experimental spaces	Learning and communication
	Innovation	Implementation	Test laboratories and Practical experiments	Project management

Table 1 Links between different process levels, objectives and activities in Transition management, based on (Loorbach 2004).

Transition policy

Transition management has been part of Dutch government policy since 2001. This can be seen as an explicit attempt to rejuvenate existing regular policy making by innovation from within. Regular policy making has a short term focus and favours a consensus approach. This is a sluggish process that starts by trying to optimize existing societal systems. As we have already observed in a wide range of areas, current policy making and in its sublime form, the polder model, lacks the strength, decisiveness and "visionarity" to confront the large societal challenges that face us today (Dutch Energy Council and Ministry of Housing, Spatial planning and Environment 2004; SER (Social and Economic Council of the Netherlands) 2001; Ministry of Housing, Spatial planning and Environment 2002). A second policy line, in addition to existing policy, is required for these specific persistent societal problems, i.e. transition policy. This is a kind of shadow policy that is more or less hidden in the political sidelines. It does not break the trend of current policy, but provides a framework for current policy in a long-term perspective of sustainability. Transition policy focuses explicitly on the long term (1 or 2 generations from now) and on implementing societal systems through a cyclical process of envisioning, agenda-building, instrumenting, experimenting and learning. Transition policy actually attempts to manage at the meso level, by creating a scaling up effect from experiments that mutually strengthen each other at the micro level (bottom-up), which is fed from a macro-vision on the design of a sustainable society (top-down). So transition policy is both top-down and bottom-up. An analysis of historical transitions demonstrates that a scaling up effect in a desirable direction hardly ever occurs spontaneously (Rotmans et al. 2004). The essence of transition policy is creating the circumstances and conditions in which a scaling up effect can take place. The argument that there are already many experiments in the Netherlands does not hold: as long as these are not systematic and not coordinated from an overarching vision, the chance that a scaling up effect will occur is minimal.

There are therefore significant differences between regular policy and transition policy, as is shown in Table 2. At the same time they cannot work without each other: transition policy without the legitimacy from prevailing policy does not stand a chance and the prevailing policy on its own is not capable of furthering and stimulating transitions.

From this perspective transition policy is a logical continuation in the evolution of policy that is characterized by network- and self-steering, multi-actor process management and the development of public support. In environmental policy transition policy implies a logical continuation of target group policy. It also fits the current complex and uncertain era in which the government is searching for a new role. There is a need for a strong, directive government that at the same time is aware of the limitations and scope for steering. The government in particular must provide intelligent guidance and should do this in cooperation with others. There is not one central actor in charge; rather there are a number of directors, who together determine the path (Rotmans 2003).

Current policy **Short time horizon (5–10 years)**	**Transition policy** **Long time horizon (25–50 years)**
Facet approach limited number of actors one scale level one domain	Integrated systems approach multi-actor multi-level multi-domain
Focused on system optimization	Focused on sustainable system innovations
Prevailing forms of steering	Mix of old and new forms of steering
Complexity and uncertainty as problem	Complexity and uncertainty as basic assumption
Regular policy arenas	Transition arenas
Linear knowledge development and distribution	Learning by doing, doing by learning and learning by learning

Table 2 Prevailing policy versus Transition policy

Transition policy requires government to take a different role and approach. Here lies the essence of the so-called transition paradox: by steering transition processes in the classical way through command, control and regulations, the government itself forms an enormous barrier to the realization of societal transitions. Transition policy does not necessarily mean more white papers, laws, rules and regulations, consultative bodies, consultancy groups, brainstorming groups, etc. – these mechanisms tend to restrict the room for manoeuvre that transition forerunners need. What transition policy does require is creating room for manoeuvre by not doing certain things,

operating intelligently and subtly, connecting, stimulating, listening, designing, anticipating, adapting and by learning.

And even though current transition policy deserves praise and appreciation – if only because of the courage and ambition shown – we should still wonder whether transition policy will actually result in the desired turn around in thinking and action. Transition policy sets high and some new demands on the facilitation of this complex process, in the analytical and organizational sense. We can ask ourselves whether government has sufficient competencies for this. The government plays an ambiguous role in transition policy: that of initiator, process facilitator, while also being an active participant. Successful transition policy demands renewed confidence in the government from other parties, something that is currently lacking. And finally, there is the international dimension of transition issues, transition policy should at least be placed on the agenda at the European level in Brussels.

But let's be careful not to just look at the issues from one point of view and not to put the ball exclusively in the government's court. Transition processes are not policy processes but societal processes. Transition policy boils down to stimulating, organizing and coordinating the societal under current of change: in other words giving direction to societal processes of renewal. This requires a different role and approach from the other participants in transition processes, which we can already see signs of in practice: companies (from short-term financial and economic return on investment to long-term societal return on investment), societal organizations (from defensive protection of interests to pro-active, creative representative) and knowledge institutes (from linear knowledge transfer as primary producer of knowledge to co-producer of knowledge with societal actors). This requires other conventions, alternative coalitions, different networks and new mechanisms for accounting, all of which takes time, because the structures, institutions and practices associated with these actors must either co-evolve or be allowed to die a natural death.

Transition instruments versus regular policy instruments

Under the notion of policy instruments we understand a range of tools for initiating, stimulating, supervising, implementing and evaluating policy processes or societal processes. These can range from a variety of actions, processes and campaigns to financial measures and public-private arrangements. Here we can distinguish between regular policy instruments and transition instruments. Under regular policy

instruments we mainly see pricing policy and regulations (legislation). For persistent problems, with a combination of market and system failures, regular policy instruments are just not sufficient. This means that new instruments are needed, as has been noted by influential government (advisory) bodies such as the Dutch Energy Council, the Ministry of Housing, Spatial planning and Environment (2004) and the Social and Economic Council of the Netherlands (2001).

Examples of these new instruments, which we call transition instruments, are:

- transition arenas to establish and further develop experimental "gardens" (Rotmans 2003);
- strategic niche management: experimenting with new technologies in an experimental space (Kemp, School, and Hoogma 1998);
- uncertainty management: identifying various sources and types of uncertainty and how to cope with these (Van Asselt and Rotmans 1996; van Asselt 2000);
- policy laboratory: simulating a learning environment for societal actors (Smits and Geurts 1997);
- constructive technology assessment: tuning technological developments to societal requirements and wishes (Schot 1991; Schot 1997);
- monitoring instrument: for measuring both content and process-oriented aspects of transition processes;
- learning instrument: for registering and evaluating different types of learning processes: learning by doing, doing by learning and learning by learning;
- new networks and coalitions: e.g. the Innovation Network Green Environment & Agro-cluster, NIDO (National Initiative for Sustainable Development), and CCT (Competence Centre for Transitions);
- new arrangements: financial or organizational stimulation initiatives.

It is important that the new transition instruments do not just supplement or replace regular policy instruments, but that they complement and strengthen each other. Regulation will become more effective if our understanding of the dynamics of the transition process is strengthened and investment can also be carried out more effectively. In this sense the contrast that is commonly created between current policy – based on pricing policy and regulations – and transition policy is based on a misunderstanding. In fact, they cannot function without each other and the one that is focused on the long term represents the means to embed the other, which is focused on the short term. Transition policy therefore requires the whole range of instruments

associated with innovation policy: financial stimulation, legislation, education and research, networks for disseminating knowledge and new instruments such as transition arenas, strategic niche management and uncertainty management.

Costs and benefits of transition policy

In its assessment of the BSIK projects [Subsidy Scheme for Knowledge Infrastructure] relating to system innovations and transitions, the Netherlands Agency for Economic Policy Analysis states that regular policy for persistent societal problems in the form of pricing policy and regulations would be more cost-effective than specific transition policy (CPB 2003). Apart from the false impression of an antithesis that is created here, this is fundamentally incorrect. Regular policy applied to persistent societal problems will almost certainly yield limited benefits against definable costs. In contrast, transition policy implies a certain risk, considering its innovative and experimental nature. However, successful transition policy will almost certainly yield great benefits (also against definable costs). What are these estimates of considerable societal benefits based on? If we understand these benefits as the avoidance of societal costs, then we can attempt to estimate the damage to society as a result of unresolved persistent problems. There are three components to this damage: (i) the chronic damage of a poorly performing societal system (healthcare, mobility, energy); (ii) the looming acute damage to societal systems that cannot react properly to sizable disturbances (water management, cattle farming); and (iii) the damage done in sectors where economic activities get in each other's way (for example due to inefficient use of space), which leads to high transaction costs.

As far as chronic damage is concerned estimates have been made in the area of mobility: about g500 million per annum, so roughly g25 billion (this is a conservative estimate) over a transition period of 50 years. The threatened acute damage has also been estimated for some sectors, e.g. for the economic damage caused by animal disease, which easily approaches a few billion euros per annum. This calculation was part of a full cost-benefit analysis of the transition to sustainable agriculture (Innovation Network 2004). The last damage category is the most difficult to quantify. But even if we only take the first two sources into consideration and we involve the most important 'hard' societal systems (health care, agriculture, energy, water management, construction, spatial planning, infrastructure and mobility, so not the 'soft' systems such as social security, education and integration), then this results in a conservative estimate of g10 to 20 billion per annum of potential societal damage on, approximately

2 to 5% of GNP (g461 billion in 2004). Of course this is a very rough estimate, only an indication. But it shows that the estimated benefits of successful transition policy, in terms of costs avoided, can be considerable. In other words: a policy with a little more risk provides a considerably greater chance of higher benefits than a policy without risks in the short term, but with enormous risks in the long term.

Conclusions

The drive for societal innovation towards a sustainable society sets high standards for all parties involved, which means that a great deal of resistance has to be overcome. An important condition for such a transition is a change in the dominant perspective from which society is currently viewed. The dominant short-term perspective that is focused on growth, profit and efficiency, and in which everything is expressed in terms of costs and benefits, is poor in relation to sustainability thinking. It is mainly 'head' and hardly any 'heart'. There is more to a sustainable society than just financial and economic costs and benefits. It is also about living and let live, peace and understanding, respect for people and nature, it's about well-being and prosperity, a balance between humans and their environment, between mind and materialism, between head and heart.

A transition towards a sustainable society also requires a different type of steering. This means creating room for innovation processes and creating the circumstances and conditions in which these processes can strengthen each other, enabling a scaling up effect to take place. This is not possible with existing policy alone. To achieve this, all relevant parties – the government, knowledge institutes, non-governmental organizations, companies and intermediaries – must combine their efforts and create the conditions that will make the transition to a sustainable society possible. This also means that these actors will take on new roles; they will develop new practices, and work together in a new way. This will require new competencies from all involved in the transition process.

But above all, a transition towards a sustainable society will require new knowledge and a new knowledge infrastructure. The current knowledge infrastructure is inadequate to tackle the issues raised by societal transitions. A new interdisciplinary and trans-disciplinary knowledge infrastructure is required, that focuses on effective development, distribution and utilization of the knowledge about transitions and system innovations. This will take place at the crossroads of science, policy and practice.

The Knowledge Network on System Innovations and Transitions (KSI), the Competence Centre for Transitions (CCT), and the Knowledge Centre for Sustainable System Innovations and Transitions (KCT) – established jointly by TNO and the Erasmus University – can play an important role in building up a proper transition knowledge infrastructure.

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