

BUSINESS PLAN KSI 2005

Knowledge Network for System Innovation: Transition to a Sustainable Society

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1 Summary

Today, our society is confronted with serious problems resulting from a series of 'flaws' that have gradually emerged in our systems. The energy infrastructure, agriculture, water management, space utilization, the traffic system, and the health care system are all examples of domains where people have been working with obsolete solutions, rules and institutions for far too long. At the same time, fundamental changes are taking place in the division of tasks between national authorities, businesses, and civil society. These developments and persistent problems call for new modes of governance and new strategies to deal with them.

Shifting to a Sustainable Society

The KSI Knowledge Project (KSI) departs from the perception that our society must make a shift to a *sustainable society* — one that does not leave problems to be dealt with by subsequent generations, palm them off onto other places in the world, or transfer them from one 'system' to the other. To achieve this, large-scale, fundamental changes in our society are required, transitions, which require integral, cross-sector modernizations — system innovations. In turn, these require efforts on the part of many, highly diverse parties. System innovations bring together parties from different cultures, structures, and institutions in order to contribute a range of skills and knowledge to the collective effort.

Obstacles Standing in the Way of Transition

- The process of necessary, fundamental changes runs aground, or fails to even reach the drawing board, for a number of reasons. In our project one of the major problems, the lack of fundamental knowledge about transitions and how they can be influenced and directed, is placed central. In order to facilitate the development and diffusion of fundamental knowledge on transitions, two more problems are addressed:
- Building a mechanism to establish a link between fundamental research on transitions and actual practice in order to stimulate the diffusion of knowledge-guiding transitions, and to acquire feedback on the directions the fundamental research programme should take.
- Contributing to the development of a critical mass of actors in our society with the necessary competences to professionally facilitate transitions and system innovations.

What the KSI Knowledge Project Intends to Achieve

KSI's mission is to develop and bring across the fundamental knowledge and competencies necessary to initiate and maintain sustainable system innovations and transitions. In doing so, KSI hopes to develop a lasting interaction between fundamental knowledge development on the one hand, and practical knowledge as generated with practical transition contexts on the other. KSI's focus will be on the interaction between generic transition knowledge and context-specific knowledge. This context is first the transition towards sustainable agriculture and mobility. This is represented by the alliance that has been established with Transforum and Transumo. Then in the next phase KSI will also focus on the health care sector. KSI must earn international recognition both among the scientific community and in practice, contribute to the academic knowledge pool and provide high-level support for policy and civil society.

The Need for Fundamental Knowledge Development

Transition science is a young scientific field that aims to derive general methods, tools and practices by studying past, ongoing and future transitions and system innovations in all types of social systems, particularly in the fields of agriculture, mobility and health care. Linking the results of this scientific research to real life in order to create a successful interaction constitutes one of the major elements of

KSI. Such concerted action is the only way to accelerate learning processes in society on effective strategies for transition processes. One of KSI's most important roles is to place these types of knowledge and experiences in an international context and make them generally applicable and interchangeable between systems. As a result, transitions may be furthered and accelerated.

Societal Transition as a Driver for Knowledge Development

At the core of this project is the dynamic interaction between transition experiments and the generation and application of knowledge. Societal transition processes drive and inspire the interdisciplinary knowledge development through *learning by doing* in practice. In turn, the development of new transition knowledge enables *informed action* of key stakeholders in societal transition processes. In order to realize this interaction, the KSI Knowledge Project includes three sub-programmes:

1. **Fundamental Transition Programme (FTP)** geared to the development of fundamental knowledge of transition and transition management. There are three complementary research lines within this programme: A) research on historical transitions, B) research on ongoing and future transitions, and C) research on transition management.
2. **Practice-oriented research (PO)** focusing on the development of competences, conditions and exchange mechanisms based on transition experiments in various sectors. Proposals for these research projects are selected and co-funded by organizations and stakeholders actively involved in ongoing transition processes. Many projects are combinations of FTP and PO.
3. **Testing Ground (TG)** as part of practice programmes managed by practice organizations in which KSI researchers participate. Testing Grounds are also denoted as Integrated Projects (IP's), which are practical transition experiments in which relevant stakeholders work together to contribute towards solving persistent social problems in specific sectors at the system level. The KSI focus of these Testing Grounds or Integrated Projects is on sustainable agriculture and sustainable mobility, and in a later phase if feasible on the health sector. In due course other fields may be entered, such as sustainable energy, sustainable space utilization and sustainable construction.

The **International Coordination** function, which is incorporated in the project, is indispensable in view of the intrinsic international nature of transitions toward sustainability and the related knowledge generation. For this coordination function KSI will cooperate closely with integrates the existing IHDP-IT international project office (IPO) on industrial transformation. This will ensure a quick dissemination of the KSI results, and international discussions with relevant scientists. Furthermore KSI researchers are part of EU-projects and several international networks, which will also be used to internationalise the work of KSI.

Knowledge and Competency Development and Exchange

Many parties in a range of sectors are being confronted with the question of how to further transitions towards sustainability. By increasing the explicit knowledge and experience of transitions and transition management it becomes possible to broach transitions geared toward, and based on, a preconceived goal of sustainable development. To achieve this, dynamic management of the KSI-projects allowing for interventions based on an analysis of the project portfolio, is of vital importance. This also implies that in the KSI research agenda KSI will be adjusted on the basis of insights resulting from the interaction between theory and practice. The current KSI research agenda has already been influenced by the interaction with Transforum and Transumo.

The newly established Competence Centre for Transitions (CCT), a strategic co-operation between KSI, NOVEM, TNO and the Ministry of VROM, will be the place where the interaction between KSI researchers and practice takes place.

Why a Bsik-Contribution?

The transition to sustainable development is of national and international interest and requires a broad combination of competences, expertise and investments. The various players involved, state authorities, the national and international business world, citizens, NGOs, and science all have their own responsibility in contributing to this process. The characteristics of Bsik (combination of fundamental knowledge and practice, broad scope, the variety of actors involved, the long-term orientation) makes that, apart from Bsik, there is no policy tool that fits in with the aim and approach of this Knowledge Project. The traditional financing instruments are inadequate when it comes to supporting trans-disciplinary, fundamental knowledge development in interaction with practice projects. Networking instruments undervalue the necessary knowledge development. A contribution by Bsik is the only way to provide the required impulse now.

KSI Knowledge Project in Brief

Initiative

Knowledge Network on System Innovations (Transition Toward a Sustainable Society)
(*Kennisnetwerk SysteemInnovaties; KSI*).

Participating practice organizations and networks: Transforum (Transitie Duurzame Landbouw), Transumo (Transitie Duurzame Mobiliteit, TNO, Pytheas, Habiforum, 8 voor Ruimte, Matisse

Participating knowledge institutions: Maastricht University, Eindhoven University of Technology, University of Twente, Free University Amsterdam, Delft University of Technology, Erasmus University Rotterdam, Wageningen Agricultural University, University of Amsterdam, Utrecht University, Tilburg University, and TNO. Others might be added later.

Cooperation with Transition departments

The 'Steunpunt Transitie' (representing the departments VROM, LNV, BuZa-OS, EZ and V&W) participates as a customer of the knowledge and competences that are relevant for transition management.

2 Background

2.1 About the Need for Transitions

Over the past decades, changes have been taking place in society at such a pace that it's difficult to keep track of them, let alone manage them. Pervasive socioeconomic changes have rendered existing structures and processes less effective or even brought them to a standstill. Flaws that have gradually emerged in systems have led to persistent problems. The growing awareness of the need for a sustainable society is one of the most important manifestations of the problems present day society is being faced with. Regardless of whether the widespread changes around us are threats or in fact technological opportunities, they force us to change our patterns of thinking and acting. 'Old' management concepts have lost their effectiveness. Thus we have entered a comprehensive process of societal transition. These large-scale, fundamental changes in our society call for multiple, cross-sector, cross-national modernizations or *system innovations*, all of which require efforts on the part of many and highly heterogeneous parties. System innovations bring together parties from different institutional arrangements, contributing a range of skills and knowledge to effectively tackle problems. On a fundamental level, the need for system innovation may be seen as a reflection of the fact that traditional, knowledge driven development processes have not only yielded the progress that they were aimed at, but also unintended effects and risks. Because the institutions of state, market, science and civil society (and their mutual alignment) have co-evolved with these traditional development processes, they may have fundamental flaws. A system innovation can thus be seen as the re-orientation of socio-technological development processes and the institutions in which these take place, so as to take into account, in addition to traditional criteria like social and economic progress, also concerns on side-effects and risks— that is as what Beck, Giddens and others (Beck *et al.*, 1997; Beck *et al.*, 2003) would call a reflexive modernisation of these systems.

The challenge now is how to deal with the challenges of this societal transition and the associated system innovations. The KSI wishes to contribute to a better understanding of this challenge, as well as of ways to deal with it. Empirically, while most work will focus on problems of sustainable development (especially in the areas of mobility and agriculture), part of the programme will also deal with new challenges facing health care.

Developments that bring about transition are related to institutional changes, legislation, production methods, consumption patterns, technology, and the building of new networks (and deconstruction of the obsolete ones!).

Sustainable development

As was again emphatically underscored from a global perspective during the UN's *World Summit on Sustainable Development* conference in Johannesburg, the transition to a *sustainable society*¹ is a crucial element of the transition of contemporary societies.

Transition to a sustainable society is about a shared effort to determine our future. Parties work together to find new solutions, while realizing that possibilities to influence transitions are limited. A distinctive feature of transitions is how they comprise incremental, related steps in which the parties find their way while exploring and learning, guided by, and geared toward, achieving collective long-term goals. In the KSI programme, we will focus on sustainable development in the areas of

¹ A sustainable society is one that does not leave problems to be dealt with by subsequent generations, palm them off onto other places in the world or other areas delineated or classified according to organisation, institution, legislation, or otherwise. That is, it is a development oriented not only to social and economic progress (as modernisation in northern societies traditionally did) but also on side effects and risks in terms of ecology and development opportunities for the South as well as for future generations.

agriculture (co-operating with Transforum) and mobility (co-operating with Transumo) as well as their interface in the area of agrolistics. These two areas form an interesting selection for comparative research because of the differences in the sense of urgency among core actors. Due to a number of crises the agricultural sector has developed a larger readiness for change than the mobility sector.

Health care

In both respects, health care is an interesting third area to study transitions and system innovation. Here, traditional modernisation processes have become embedded both in the infrastructure formed by hospitals and other medical centres, an extensive knowledge infrastructure, policy routines and a culture in which many people entrust their health to this professionalized health care system. In terms of the sense of urgency, the notion of transitions and system innovations are as yet hardly mentioned. However, side effects and risks of the traditional modernisation processes that have characterised the health care system for such a long time now seem to be adding up into an increasing pressure for system innovations (Grin, 2004). These include:

- the pressure for a more demand-oriented, less professional-dominated system so as to improve quality and accessibility and simultaneously reduce costs (Grin *et al.* 2004; M'charek & Willems, 2005);
- The fossilized relations between the major players in the health care system: government, health care insurers, hospitals and insureds, with a dominance of health care insurers rather than the patients (Rotmans, 2003);
- the increasing awareness that diversity of clients, their life conditions and their health problems is inadequately taken into account in health care practices and in medical research (ZONmw 2004; M'charek & Kohinor, 2005; Wieringa *et al.*, 2005);
- the shifting, transforming or even disappearing boundaries between health care and other domains (such as welfare – Grijzen *et al.*, 2004; labour – RGO (2003); Veenstra & Rikken, 2003; and food – Rougoor *et al.*, 2003).

This creates the need for a fundamental shift of the health care system towards a balance between demand- and supply-orientation and between curative and preventive aspects of the system. However, this requires a re-orientation with regard to the deeper structure of the system and the role and working methods of the prime actors involved, but there are still no obvious signals that indicate the seeds of change as forebodes for such a re-orientation.

The need for knowledge on transitions and system innovations

A great deal of the knowledge necessary for initiating these innovations, directing multiple system innovations, and linking them to achieve transitions, has yet to be developed. The required new fundamental knowledge will make it possible to recognize, manage, evaluate and pass on the processes that stimulate and facilitate desired transitions. This fundamental knowledge, along with the competencies to effectively use it in practice, provides society with the tools to manage transitions more effectively. It should be pointed out that it is not a single party that develops this knowledge, which is then 'applied' further downstream. Instead, a heterogeneous group of private and public parties work together to collectively determine the knowledge agenda and ensure the exchange between practice and fundamental knowledge development. Their collective role is completely in keeping with the mutual responsibility that these parties assume for an attractive and prosperous society. What is more, it means that all these parties must have the fundamental knowledge and competencies to fulfil this crucial role.

Society stands to benefit greatly from investments in developing fundamental knowledge and competencies to pave the way for transitions and keep them in motion. The result is gaining perspective about solutions to problems arising from the failure to think and act at the system level, such as when one party acts independently or incorrectly estimates the system's reaction. It offers transferable knowledge and insights to start working together, developing new types of solutions

where technology alone no longer suffices, or puts additional strain on a system in areas such as mobility or food integrity. It accelerates the initiation and wider implementation of essential changes such as sustainable business practices, the introduction of new technologies such as energy supply systems, doing business based on new knowledge combinations and new concepts for more effectively dealing with scarcities in our society.

KSI seeks to contribute to filling the lack of knowledge on transition processes. KSI will be drawing on a large number of different disciplines, including policy studies, integrated assessment, complex systems science, innovation studies, evolutionary and institutional economics, sociology and history of technology. The requested emphasis of the Government on a more pronounced role of economics, will be endorsed through both integrating evolutionary and institutional economists into several projects and paying more attention to the role of economic principles in transition processes.

Economics

Through the Ministry of VROM KSI was asked to strengthen the knowledge base with more input from the economic discipline. Three of the project leaders are economists with a prominent role in the KSI network (prof. J. van den Bergh, prof. A. van der Veen, dr. R. Kemp). In several projects there are economists part of the core team (e.g. Verspagen, Nuvolari, Tappi). For future projects cooperation with prof. Witteloostuyn and prof. Nooteboom are foreseen. Several PhD students in the Programme have a background in economics.

2.2 Embedding in the Activities of the Consortium Participants

Implementing KSI runs parallel to consortium participant activities and ambitions. The most important participants are the knowledge institutes (universities, research institutes and educational establishments), practice organizations (the term used for organizations attempting to achieve system innovations in actual practice) and the government:

1. **Knowledge institutions:** universities, research institutes and educational establishments. Two activities within KSI belong to their core business, namely: performing scientific research and passing on knowledge. For applied scientific research organizations such as TNO (Netherlands Organization for Applied Scientific Research) and NOVEM (Netherlands Agency for Energy and the Environment), KSI activities fit in with their intermediary position between fundamental knowledge development and its socially-relevant application.
2. For **practice organizations**, in particular Transforum (transition towards sustainable agriculture) and Transumo (transition towards sustainable mobility), but also Habiforum, Innovatienetwerk Groene Ruimte and PSIB, developing and realizing system innovations are their main objective and justify their existence. For the development of a transition research program for the health care sector we also aim at developing sustained and in-depth relationships with specific organizations involved in facilitating a change process.
3. For the **government**, implementation of the Knowledge Project fits in seamlessly with its overall activities designed to stimulate the reinforcement of the knowledge infrastructure, and more in particular the reinforcement of the interface between the knowledge infrastructure and users. The goal is to gain knowledge and experience that will help society respond to new insights and developments in a dynamic and flexible manner. The work of KSI should also strengthen and assist the work of several Ministries and their partners on transition trajectories.

2.3 Strategic Context and Goals

Fundamental changes must be realized for societal transition and associate system innovations towards a more sustainable direction. KSI was developed within the *context* of the generally endorsed need to accelerate and improve the sustainability process *at the system level* in numerous segments of society. The *objective* of the Knowledge Project is to make a contribution towards meeting this

need, as well as to better understanding the systems innovations that may emerge in the domain of health care. Doing so comprises three mutually related elements:

1. Developing scientific knowledge.
2. Furthering system innovations and conducting practical experiments (and feeding results back to the development of scientific knowledge).
3. Passing on knowledge and experience to the parties that play a role in furthering and implementing system innovations in practice.

In a world that must learn to live with its limitations, scientific knowledge and competencies are strategic assets, allowing all parties who play or wish to play an active role in society to find the best possible position within these boundaries. Each party active in this Knowledge Project has its own strategic interests and objectives.

The project's goals, working methods and yields², as well as the consortium participants' strategic interests and objectives, determine the strategic context of the KSI Knowledge Project.

- The project is very important to **knowledge institutes** in that knowledge development brings various disciplines together and mobilizes them to make adjustments on behalf of developments that are highly relevant to society. The Knowledge Project directly contributes to repositioning university research and applied scientific research into the core of society. Given the fact that transition science is still regarded internationally as new, and the Netherlands is taking a leading position in that science, the Knowledge Project offers knowledge institutes the opportunity to reinforce that position and to claim a long-term leading role in linking fundamental knowledge development and its application in society.
- The Knowledge Project allows **Transforum and Transumo** (and, in due course, other practice organizations, working toward system innovations and transitions) access to relevant scientific knowledge and competencies. Moreover, intensive interaction among these organizations on the one hand, and researchers involved in transition sciences on the other, create a *community of practice* in which new knowledge questions are continuously coupled with possibilities for application in practice.
- There are two strategic interests for the **government**. Participating in the Knowledge Project fits in with, and adds to, policy initiatives, particularly those launched by the five transition departments (Ministries of Housing, Physical Planning and Environment; Agriculture, Nature Management and Fisheries; Foreign Affairs - Development Cooperation; Economic Affairs; and Transport, Public Works and Water Management). Implementation of the Knowledge Project also responds to the overall policy goals to increase competitive strength and quality of Dutch society in relation to building up the knowledge infrastructure, also in a transnational manner.

Obviously, **business** is also involved in transition processes, in particular through their involvement in practical transition experiments. In KSI they are involved through the alliance with Transforum and Transumo. Taking part in experiments geared toward developing and testing new concepts for sustainable business in practice distinguishes them from other businesses that have yet to gain similar knowledge and experience and creates a strategic advantage that can allow them to repeatedly make competitive advances. For **NGOs**, the strategic importance of participating is that it will provide them with the knowledge and means that they need as active and frequently initiative taking parties.

At **national level** a general interest exists for all parties involved in ongoing and future transitions in sectors of our society. Participating in KSI can help them to deploy system innovations faster and with

² 'Yields' are fundamental and applicable knowledge, networks, knowledge infrastructure reinforcement, people with competencies and the exchange of knowledge and experience.

sharper focus and manage them more effectively. Moreover, they share knowledge and experience of transitions in which they are not taking part but of which they might learn, and profit directly from the fundamental knowledge accumulating about transitions and transition management. The interaction among these participants, and the of linking theory and practice, is an integral characteristic of KSI. Transitions do not stop at national borders. Real sustainable solutions will always be 'international' in that they never pass problems off onto other countries, and our open economy, the European Union and all international networks involved, make it impossible to contain the effects of 'national' system innovations to national boundaries.

3 The Core of the KSI Knowledge Project

3.1 Vision and Mission

The KSI vision is that the Netherlands must have a knowledge network for the development, application and transfer of knowledge on the transition and system innovations, focusing on the transition towards a sustainable society. The KSI mission is to realize this type of network for the continuous development of fundamental knowledge required for furthering and stimulating transitions and system innovations that are desirable from a social perspective. Moreover, the network must make the knowledge available. KSI aims to develop a lasting interaction among fundamental knowledge development, competency development and questions raised by Dutch society. Also, KSI aims to earn international scientific and societal recognition. And finally, KSI aims to provide high-level support for policy, NGOs and the Dutch business world.

3.2 Problem Analysis

In section 2.1 we indicated that system failures ('flaws') that have gradually emerged in systems have created persistent problems in our society. In order to tackle these system failures we need to realize radical, long-term changes — transitions — based on connected system innovations. System innovations are recognizable by their cross-sector, long-term character and how they demand change from the structure and culture (institutions and rules) in which they take place. These very characteristics form one significant obstacle that stands in the way of desired changes arising and maintaining momentum. As a nation, the Netherlands loses its competitive strength if it fails to increase its capacity to improve stagnating systems in a sustainable fashion.

One prerequisite to activating system innovations is recognizing the nature, direction, and timing of the transition of which the system innovation is a part. Another is being in possession of the knowledge to perceive what type of transition is necessary, and to translate it into the goals that a system innovation must help to achieve. So far, these prerequisites have not been met. While a number of practice organizations (including in ICES/KIS-II) have started this knowledge development, there is insufficient knowledge to systematically and confidently carry out these analyses. The ongoing differentiation and specialization of knowledge areas and disciplines in the Dutch knowledge infrastructure has co-evolved with traditional modernisation processes and thus is much less appropriate for, or even hampers, the development of transition knowledge. Transition research calls for an infrastructure which is characterized by the integration of knowledge areas. The lack of an integrated knowledge infrastructure is one of the major problems facing conscious and timely transition stimulation³. There are very few well-documented examples of system innovations that have been initiated consciously and implemented successfully. Pioneers who see the need to act outside their own arena have little to go on and do not know how to minimize the risks. Thus, the key to finding solutions is by conducting fundamental research on the one hand and by gaining practical experience on the other, and then linking the results of both in an intensive, innovative and systematic manner.

³ In their analysis of the existing knowledge infrastructure Jansen en Weterings conclude that the lack of coherence, of demand orientation and of long-term orientation are the main structural shortcomings in the knowledge infrastructure for sustainability. See: J.L.A. Jansen and R. Weterings (2000) Specification ICES knowledge theme Sustainability. Towards an Innovation network for sustainable development.

In KSI one of the major problems, the lack of fundamental knowledge about transitions, or about how they can be influenced and directed, is put central. In order to facilitate the development and diffusion of fundamental knowledge on transitions, two more problems are addressed:

- Building a mechanism to link fundamental research on transitions with actual practice in order to stimulate the diffusion of knowledge-guiding transitions and to acquire feedback on the directions the fundamental research programme should take.
- Contributing to the development of a critical mass of actors in our society with the necessary competences to professionally facilitate transitions and system innovations.

KSI intends to develop a solution to each of these problems in cooperation with practitioners.

3.3 Objectives and Key Questions

KSI's *objectives* can be summarized as follows:

1. Develop a qualified network of knowledge institutes rooted in the Dutch knowledge infrastructure in the area of transitions, system innovations and sustainability.
2. Generate fundamental multidisciplinary, interdisciplinary, and transdisciplinary knowledge on transitions and system innovations.
3. Develop tools, methods and practices required for analysing, monitoring, managing and evaluating transitions.
4. Test the fundamental knowledge and practical tools and methods in Testing Grounds or Integrated Projects
5. Develop competencies among social actors to help further and manage transitions and system innovations.
6. Develop a dynamic mechanism with which to link fundamental scientific research effectively with experience gained from practice projects.
7. Embed the Knowledge Project in an international environment.

The key scientific questions are:

- What are – scientifically derived and validated – the characteristics and dynamics of transitions in relation to the system in which they occur, and in relation to the possibilities actors have to influence them?
- In what way – applying knowledge and competences – may transitions be facilitated in order to gain the highest possible social benefits for society?

3.4 Knowledge Project Strategic Lines, Structure and Products

3.4.1 The KSI Knowledge Project Comprises Three Components for Knowledge Generation

In the research program, a distinction is made between three areas in which knowledge development takes place.

- The *Fundamental Transition Programme (FTP)*. This concerns the development of a fundamental knowledge basis for transitions and system innovations.
- *Practice-Oriented Research (PO)*. This concerns the development of competence kits (such as software tools, learning histories, regime analysis methods) and competence transfer mechanisms (such as modules for on-the-job training), and is directly linked with the FTP and the Testing Grounds or Integrated Projects .

- *Testing Grounds (Integrated Projects)* will be defined within practice programmes in consultation with KSI to provide research support on specific knowledge questions.

Intensive and dynamic interaction exists in each of the areas. This interaction serves a twofold goal:

1. To guide research within the FTP by fundamental questions raised in the PO and IPs;
2. To improve Testing Grounds (Integrated Projects) through using the knowledge developed within the PO and FTP;

Activities in each of these areas have their own criteria (see the next section).

3.4.2 Dynamic Project Management and Programme development

The very nature of KSI, with its strong systemic character, makes it impossible to map out a detailed research and knowledge agenda in advance. Nor is it possible for a singular participating party to determine the agenda on its own. Therefore, the KSI Knowledge Project strives after dynamic project management, implying regular reflection at project level and at the level of KSI in order to decide whether or not adjustments in goals, approaches or cooperative arrangements are necessary. The following describes how programming will take place in this Knowledge Project.

Programming the Fundamental Transition Programme (FTP)

FTP research is mainly inspired by the wish to gain a better understanding of the transition phenomenon, including the underlying system innovations. The goal of this multidisciplinary, interdisciplinary and transdisciplinary research programme is to synthesize and deepen our understanding of past, current and future transitions through the development of theoretical knowledge on the one hand, and practical knowledge on the other in mutual coherence, both of which are generic by nature, i.e. not specific for one transition domain but valid for all transition domains. The primary question used to test project proposals is how far the project will contribute to a better understanding of the transition phenomenon or to the development of the necessary tools and methods.

FTP research should satisfy specific criteria such as:

- the research needs to be multidisciplinary, interdisciplinary or transdisciplinary;
- the research must be of excellent scientific quality and be oriented towards transitions and system innovations;
- the research must be done in association with other research groups;
- the research must have a link with sustainable development;
- the research must be based on the shared concepts that are described in the FTP-research programme;
- the research needs to cover multiple transition domains;
- the research must build upon currently ongoing research within the research group;
- the research needs to demonstrate, at least potentially, the link with practice.

A portfolio of projects, selected on the basis of these criteria, will be executed during the first years of the programme. Financial space (about 30%) will be reserved for additional projects. We are seeking to establish a number of larger research groups and centres that have integrated the research on transition into their mission. The projects out of the initial portfolio will present their results and be evaluated on a yearly basis during a two-day workshop. Based on the results of this workshop, and after consultation with an International Advisory board (the members of which will attend the two-day workshop), the KSI management board will present a progress report in which feedback for ongoing projects and specifications for 2nd phase and integrative projects are formulated. Scientific quality, contribution to the overall programme and international positioning will be the major criteria used

during this evaluation. The International Scientific Advisory Board will consist of leading experts in the field of transitions and sustainable development. This dynamic programme management guarantees an ongoing reflection on the future course of the programme.

Integration project

In order to achieve integration between the three sub-programmes, both on the FTP and the PO level, integration activities will be carried out throughout the KSI programme. These activities will be organized around the following integration lines:

- Conceptual integration: major transition concepts as the multi-level concept, multi-phase concept, transition management, strategic niche management and reflexive governance, will function as cross-cutting, interdisciplinary mechanisms that play an integrative role in almost all KSI-projects. Apart from the existing concepts new concepts will be developed as part of a coherent conceptual framework for transitions.
- Thematic integration: sustainable agriculture, mobility and health care are the focal areas of many KSI-projects. Inter-comparisons among these transition domains enable the possibility of searching for the right balance between genericity of transition concepts on the one hand, and domain-specificity required on the other hand.
- Communicative integration. This involves the process of organising integration in an instrumental manner, by creating a number of avenues for sustained interaction among researchers that will be established: ranging from an annual conference, smaller focussed workshops, to an annual summer (winter)school for Ph.D students, and regular meetings of a Core-Group of project leaders. All meetings are heavily substance-oriented, aiming to further develop theoretical and practical knowledge base of transitions.
- Product integration. The program will seek to establish its own Book Series and will develop an incentive structure for joint publications of researchers working in different projects and research lines; This publications might also be co-authored by international scholars.
- Cooperation on developing tools and instruments for transition practices, including the development of a coherent tool framework that organizes, relates and discloses the various PO products in a user-oriented way.

The issue we want to convey is, that we do not only seek collaboration on a personal and institutional basis, but also on a cognitive basis. The research programs aims at developing insights resulting from interdisciplinary and transdisciplinary cooperation. The most important platform for developing these new insights will be the Core-Group of project leaders. This Group will also include a number of people working in the transition practice.

Selecting Testing Grounds (Integrated Projects) Whether a project qualifies as a Testing Ground (Integrated Project) for KSI related research depends on certain criteria, including:

1. The project must revolve around a sustainability goal.
2. The underlying system innovation should be obvious, and the associated, intended project result and the relationship with other projects aim at the same system innovation.
3. The project should be innovative in the sense that new methods are tested or a new system concept is being developed. At the same time, the degree to which the project uses lessons learned from earlier innovation projects should be clear. The project's learning objectives must be clear and it should be possible to systematically record and pass on results.
4. It should be clear that the project involves players from the four spheres: government, NGOs, private parties and knowledge institutes, and that these participants belong to the 'opinion leaders' in their field.
5. A connection with and added value in relation to the other IPs.

Testing Grounds or Integrated Projects will be selected co-operatively between KSI, Transumo and Transforum and perhaps in future other partner organisations. KSI management assumes responsibility for choosing the IPs in which to participate. This choice is based on the contribution that participation might lead to in terms of gaining better insight into the transition phenomenon and/or obtaining opportunities to test or further develop methods and tools on the one hand, and the commercial conditions under which participation can take place on the other. KSI contributions to Testing Grounds (Integrated Projects) will be funded by practice organizations. In the initial stage of the programme, KSI prefers to focus resources on three of the Testing Grounds (Integrated Projects): one with Transforum, one with Transumo and one with both.

Managing Practice-Oriented Research

In practice-oriented projects, knowledge obtained in the FTP programme and insights that have appeared useful in the Testing Grounds (Integrated Projects) are synthesized into competence kits (see Chapter 8). Also part of the PO programme is the development of competence transfer mechanism.

PO projects will be funded by the KSI programme. A PO project must satisfy five criteria:

1. It must fit within the established guidelines.
2. It must be of a relative short duration (roughly 1.5 to 2 years).
3. It must be generic; results must be relevant to more than one Practice Programme.
4. It must be scientifically advanced.
5. It must be supported by more than one practice organization.

3.4.3 The Products

The KSI programme structure is designed to create an environment in which links between scientific research on transitions and the practice thereof form a self-evident condition for realizing transitions to a sustainable society. Products emerge within this environment that can be described mainly in terms of knowledge and competencies.

- *Knowledge* about transitions: how they emerge and progress, the dynamics involved, the roles of actors, success and failure factors, coordinating mechanisms and so forth. This knowledge becomes manifest in theories, models, methods, tools and competencies.
- *Competence kits and competence transfer mechanisms* as a combination of the knowledge, skills and attitudes needed to further and manage transitions. These competencies become manifest in individuals and organizations that facilitate transitions and/or in those who interpret and elaborate on them in their field of activity.

3.4.4 Connections to the 6th EU Framework Programme and Internationalisation

Reinforcement of the European knowledge infrastructure

Through the 6th EU Framework programme on Research and Technology Development 2002 – 2006 (FP6) the European Commission intends to strengthen international networks and the European knowledge infrastructure in general. KSI will contribute significantly to at least two FP6 theme's: 'sustainable development, global change and ecosystems' and 'citizens and governance in a knowledge-based society'. KSI researchers are participating in various projects and networks of the Framework Programme, for example:

- the MATISSE-Integrated Project on tools and methods for sustainability,
- the E-VIA Network of Excellence

The internationalisation of the research programme will also be furthered in a number of other ways:

- Through publications, paper presentations at conferences, organization and participation in international workshops, and the production of a comprehensive English website;
- International scholars will participate with Dutch scholars in several KSI projects, both formally and informally. In some cases it is anticipated that this will lead to the hiring of international scholars;
- Invitations to international scholars to participate in KSI summerschools, workshops, annual conferences, and a possibly a KSI Lecture Series:
- The encouragement of joint key publications of Dutch and international scholars, including a Book Series (see 3.4.2)
- Exploration of the need to establish a new international journal on Transitions towards Sustainable Development;
- Collaboration with the International Scientific Board to be established in 2005.

These activities need to be placed within the overall intention to gradually turn the KSI-network into a European and ultimately worldwide network of transition researchers and analysts.

Several of these objectives will be organized in collaboration with the secretariat of the Industrial Transformation Programme within the International Human Dimensions Programme on Global Environmental Change (IHDP)

4 Scientific Research on Transitions and System Innovations

4.1 The Scope of KSI

KSI's activities comprise FTP, PO and TG (IP) (see section 3.4.1). The object of the fundamental research programme includes historical, ongoing, and future transitions and system innovations aiming to promote a sustainable society. The object of the practice-oriented research concerns the development of instruments and competence kits for transitions and system innovation. These include, e.g., a monitoring system for transition, an uncertainty management system, a database of historical transitions, methods for defining system innovation projects, and an evaluation framework for transition experiments. Furthermore, a competence base will be developed that provides insight into what kind of competencies, in what phases, and what kind of persons are needed. In Testing Grounds (Integrated Projects), KSI researchers provide practitioners with knowledge and competencies; conversely, these TGs provide KSI researchers with empirical data and experiential insight on system innovations and transitions, and help to formulate relevant knowledge needs. A project portfolio has been selected that does not entirely cover the full range of research questions as postulated in this Chapter, but is representative for the breadth and depth of the research questions.

4.2 Research Programme on Transitions and System Innovations⁴

4.2.1 Introduction and shared concepts

Introduction

The concept of transition has been studied for many years in several disciplines. The sociological concept of transition has its roots in biology and population dynamics (Davis, 1945), describing the demographic transition which has become a historical fact in approximately 30 countries all over the world (UN, 1997). The economic concept of transition was put forward by Rostow (1960) and Boulding (1970) and is mostly used as the multi-staged development from a controlled economy to a market economy, accompanied by the evolution of new political and social institutions. From the socio-technical angle, transitions have been studied by Rip and others alongside the notion that technological transitions occur as an outcome of linkages between developments at multiple levels (Rip and Kemp, 1998; Schot, 1998; Geels, 2002). From a complex systems theory point of view, transitions could be considered as system transformations from slow equilibrium dynamics to quick development and instability, reverting to relative stability (Rotmans, 1994; Rotmans et al., 2000). The new equilibrium is a dynamic equilibrium, i.e. there is no status quo, because a great deal is changing below the surface. All these research approaches have their (multi)disciplinary function and added value, but not a single one of them is comprehensive enough to address the complex nature and multiple dimensions of broad societal transitions. In general, science approaches the complex phenomenon of transitions and system innovations in a too fragmented manner, studying the various interconnected pieces in isolation. The existing international knowledge base on transitions and system innovations is relatively immature, and requires deepening and broadening, and needs to be translated in order to enhance the usefulness for policy objectives (Rotmans et al., 2001). The challenge of KSI lies in developing a more integrated perspective on transitions, fruitful for the further development of science and useful for society.

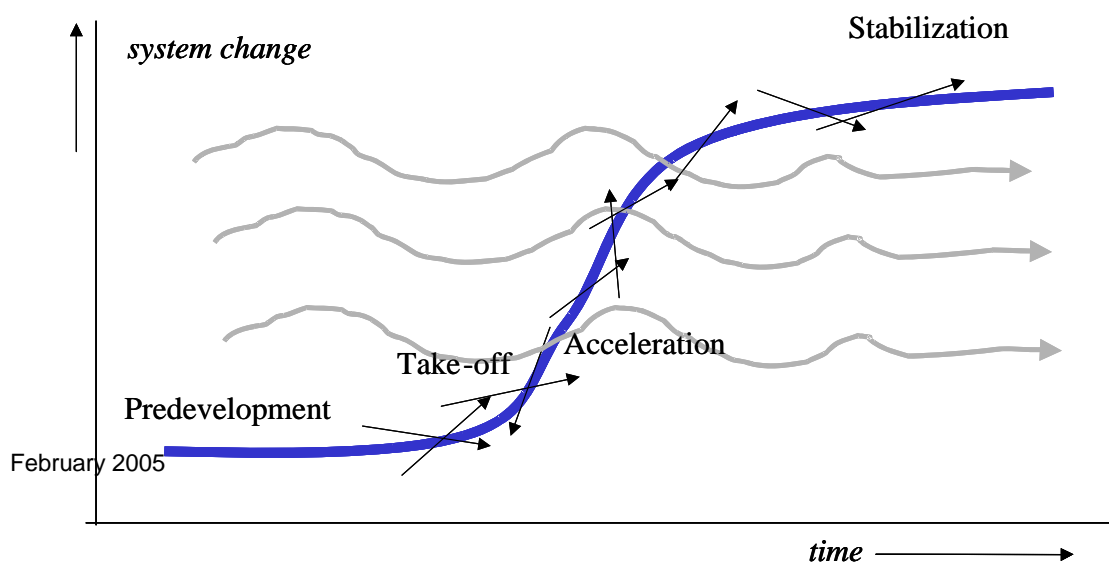
⁴ See also Appendix A.

Shared Concepts of the research programme

The proposed research programme on transitions and system innovations is based on a set of shared concepts in order to safeguard the coherence between the various research angles.

- The first common research principle is that of *co-evolution*. Although the term co-evolution has different meanings in different disciplines we speak of co-evolution if the interaction between different systems influences the dynamics of the individual systems, leading to irreversible patterns of change. Within the context of transitions and system innovations co-evolution has been dealt with only partially: e.g. co-evolution between science and technology, between culture and technology and technology and society (Geels, 2002). In innovation studies the concept of co-evolution is used to describe the interactive development of universities, society and industry (Leydesdorff & Etzkowitz) as well as the interactive development of innovation theory, innovation policies and day to day innovation processes (Smits & Kuhlmann, 2002). These processes of co-evolution in innovation processes are given even more emphasis because of the rise of the systems perspective in innovation studies, including a focus on the dynamics of system development, learning and experimenting (Lundvall, 1988). They have been shaped by the programme of knowledge-driven progress, characteristic for modernity (Schot *et al.*, 2003), the unintended effects and risks of which are now creating the need for transitions and system innovation (Grin, 2004). However, a comprehensive study of co-evolution in broad societal transitions and system innovations is lacking.
- A second shared concept concerns a *transition framework*. Such a framework may serve as a bridge between the different disciplines studying partial aspects of transitions and system innovations. The scientific literature shows that such a framework is still lacking (Weber, 1997; Berkhout e.a., 2002; Rotmans et al., 2000; Geels, 2002). Being aware of this, we use a preliminary framework that consists of two transition concepts. These building blocks unfold the contours of a transition theory which is still in its infancy. The transition theory holds that the dynamics underlying a structural long-term change of societal subsystems can be described, explained and influenced using these transition concepts.
 - the *multi-stage* concept, which describes a transition at the conceptual level in terms of four stages or phases: a pre-development phase, a take-off phase, an acceleration phase and a stabilization phase (Rotmans et al., 2000), see Figure 4.1. These four transition phases seem to coincide with the four phases that Holling discerns in the development of complex (societal and ecological) systems: exploitation, conservation, release and reorganization (Gunderson and Holling, 2001). In this way one can describe the nature of change in each stage of the transition in terms of 'degradation' and 'breakdown' versus 'build up' and 'innovation'. In Smits et al., (2001) these phases are linked to concepts derived from innovation (system) studies.

Figure 4.1: The different phases of a transition (Rotmans et al., 2000)



- The *multi-level* concept, which describes a transition at the conceptual level in terms of three interfering scale levels, i.e. the micro-, meso- and macro-level (Geels and Kemp, 2000), see Figure 4.2.

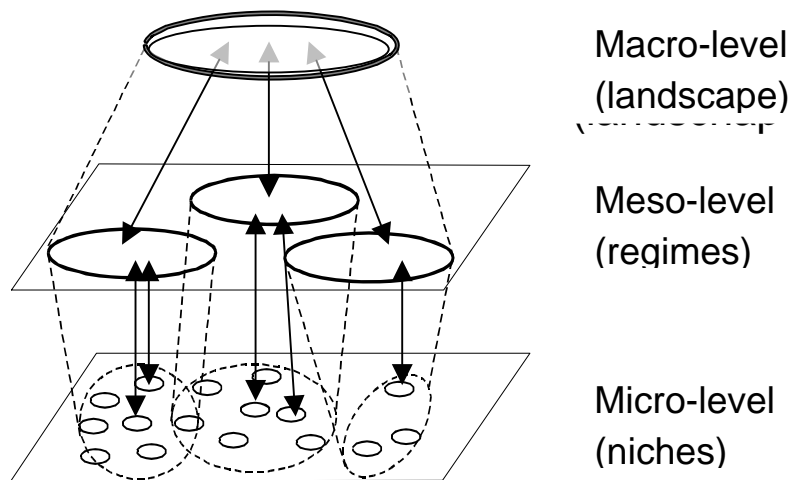


Figure 4.2: Interaction between different scale-levels (Geels and Kemp, 2000)

- The third shared concept is that of *transition management* (Rotmans et al., 2000; Rotmans, 2003), a model of goal-oriented modulation, involving multi-level coordination through transition goals, arenas and agendas and the use of visions and orientation of policy and societal interactions to learning and innovation. It is a forward-looking, adaptive type of governance which can be viewed as evolutionary governance because it opts for long-run change through small steps.
- A fourth shared concept is the notion of *non-linear knowledge generation*. This means that knowledge is developed in a process of co-production with a range of stakeholders involved. Only through frequent confrontation of theoretical knowledge with actual practice does an innovation assume its ultimate shape and can sink in at the system level. Knowledge institutions then become co-innovators in new innovation-creating networks, which fits into the context of the currently ongoing switch from mode-1 science to mode-2 science as postulated by Gibbons et al. (1994). It is our aim to establish a multidisciplinary, interdisciplinary and transdisciplinary research programme which is directed towards knowledge development, knowledge diffusion and sharing through interaction with society.
- The fifth and final shared concept concerns the *three major research lines* along which the research programme on transitions and system innovations is structured. The structure has been discussed extensively in KSI, the Dutch Knowledge Network System Innovations: Transitions to a Sustainable Society that has been established in 2001 and in which 10 Dutch universities and other knowledge institutions are involved. The following research lines have been defined (see section 4.2.3 for more details):
 1. Research on historical transitions and system innovations
 2. Research on current and future transitions and system innovations
 3. Research on governance of transitions and system innovations

Apart from the KSI focus on transition domains as sustainable agriculture and mobility, a new, emerging transition domain for KSI will be health care. In order to do justice to the specific nature of the health care system as transition domain, a definition study will be performed in 2005, on the basis of previous research on health care by several KSI-researchers. In this study, it will be identified

which research questions developed in the coming sections are most relevant for health care, and what additional questions may be important to ask for this domain. Resources have been reserved for projects on these questions to be started in 2006. Meanwhile, where projects already starting offer opportunities (in terms of the questions they ask, and the expertise present within the group) for analysing cases in health care, these have been included.

As mentioned above two transition domains have been selected as research foci: agriculture and transport, because of the alliance with Transform and Transumo. This leaves open the possibility for taking additional transition domains in the near future, such as multiple space use, energy, construction, water and health care.

The following rationale underlies the choice for these three lines of research. A better understanding of historical transitions paves the way for a better understanding of ongoing and future transitions, in terms of describing, recognizing, explaining and monitoring them, which in turn allows for a better understanding of how to govern them in evolutionary management terms. While the three research lines are distinctive they overlap in the sense that some transition research issues are consciously addressed from more than one research angle. For instance, the concept of transition management is addressed from a complex systems approach as well as from a constructivist-theoretical and governance approach. This illustrates the multidisciplinary and interdisciplinary character of the programme and its plural richness.

4.2.2 General Research Objective, Hypothesis and Methodology

General Research Objective

The multidisciplinary, interdisciplinary and transdisciplinary research programme of KSI aims to synthesize and deepen our understanding of past, current and future transitions through the development of theoretical knowledge on the one hand, and practical knowledge on the other in mutual coherence. Both are generic by nature, i.e. they are not specific for one transition domain.

Research Methodology

The methodological repertoire consists of various components: *theory development* through theoretical desk-study research, *theory testing* through empirical case-study research and *comparative analysis* (comparing transition patterns in different domains and/or in different countries or regions). This is explained further below when we describe the different research lines in more detail.

The methodological basis for the research components into past, ongoing and future transitions and system innovations is formed by the theoretical framework spanning the two transition concepts (multi-stage and multi-level). On the basis of this theoretical framework and a preliminary consultation of policy-makers about their research demands, for each of the research lines a series of research questions is formulated which serves as a guideline for the set-up and execution of the research lines and concomitant research projects.

Research Questions (both theory-driven and practically-oriented), clustered along the various research lines:

1. Research questions for Research line I on historical transitions

- *What can we learn from historical transitions and system innovations? Can we distinguish between different transition paths? To what extent were these historical transitions foreseen, expected and intentionally managed? What were the main success and failure factors?*

2. Research questions for Research line II on current and future transitions

- *How can we recognise in advance, or in an early stage, in which phase of a transition we are? And how can we monitor the different phases of a transition? Is it possible to develop a generic framework for monitoring transitions, and for testing and evaluating transition experiments. If so, what would it look like. Does such a monitoring framework need to be context-specific? How to achieve this?*
- *Is there a generic pattern to be found in the driving forces of the various past and current transitions and system innovations? Is the co-evolution between economic, technological, institutional and social-cultural factors generic by nature, or does it unfold a transition-specific pattern?*

3. Research questions for Research line III on the governance of transitions

- *What are the possibilities for managing transitions and system innovations? What are the components of a new steering model for influencing these societal transformation processes? What are the major barriers and opportunities for influencing them, and how can we avoid potential lock-in and lock-out patterns? What is the international context for initiating, promoting or stimulating transitions and system innovations?⁵*
- *Which tools and instruments are available to initiate, stimulate, implement and evaluate transitions? Which tools are adequate to enhance the competences of the diversity of actors involved in transition processes? And which tools and instruments still have to be developed in the near future?*

Research Hypothesis

We cannot not formulate a hypothesis 'strictu sensu', but we formulate a provisional research hypothesis, realizing that it can only be tested in a partial and relative sense and that it might be adjusted during the research period. *The basis hypothesis which is tested in this research programme is that the theoretical transition framework consisting of the three interrelated transition concepts as described above forms a sound and adequate heuristic framework in order to describe and explain the complex dynamics of societal transformations.* So far the scientific evidence for the legitimacy of the theoretical transition framework as overarching framework for structuring complex societal transformation processes in time, scale, nature and management has been far from sufficient. Nevertheless, there is enough common scientific ground to presume that the theoretical transition framework is a useful and adequate aid for studying transition processes.

4.2.3 Description of the research lines (sub-programmes)

Research Sub-programme I: Research of historical transitions

Historical research is important for four reasons. The first being that existing socio-technical systems are stable because of path dependencies and lock-in. The second reason is that historical research can test and further develop the transition theory. Historical research is important, because this is the only way to study the *entire* life cycle of system innovations. We can formulate hypotheses and *test* them with historical cases. We can also explore interesting themes. To these ends it is important that the cases in the database are sufficiently wide and varied, enabling a systematic investigation of the importance of relevant variables. The third reason is that historical examples can be used in education, for courses and for competence development. Because the proposed programme aims to describe all historical system innovations with a similar research-protocol, comparisons become

⁵ With regard to the European dimension of transitions to sustainable development it is referred to Weaver and Janssen (2002).

possible, and a didactic systematic emerges for use in education (see below). The fourth reason is that historical examples can be used as a mirror for the present, which may lead to heightened reflexivity of policy makers and people from practice. To capture historical research the research programme is organized along research line axes.

The first line is to widen the empirical basis of the multi-level perspective, and work on further refinements, in particular the identification of a number of different transition pathways (project I.1). The second line consists of the *exploration of a number of transition themes* (project I.2 and I.3). Both lines aim to further develop transition theory (I.2, I.3). The third line consists of a more fundamental reflection on the nature of the contribution of historical knowledge to transition theory and practice (project I.4).

The first research line will take as its point of departure the distinction developed in the first phase of the project between five different routes:

- a) Substitution with knock-on effects;
- b) De-alignment and realignment;
- c) Gradual reconfiguration;
- d) Opening up of new domains;
- e) Transformation;

For a first description of these pathways we refer to Geels and Schot (forthcoming).

The empirical basis of this first line will consist of a database of 12 cases in a number of areas, including energy, transportation, agriculture and health care. This basis might be broadened depending on the development of the research. For these case-studies the entrance point to study transitions and system innovations is the intertwinement between social and technological change. The database runs from around 1900 up to the present, so that it will include recent analyses of path dependencies in relevant sectors.

The case study research will be qualitative (see research methodology). To make a comparison of the case studies possible a case study protocol will be used, based on the multi-level perspective. Using this protocol, the basic dynamics of all historical case studies will be mapped and described. This protocol encompasses the following elements:

- Phases: Distinguish between different phases:
- Multi-level dynamics: For each phase describe developments at landscape, regime and niche level;
- Dimensions of change process. For example: describe role of new entrants, incumbents, strategic games, governance, societal embedding, networks.

The case-study approach will be complemented with the development of a mapping tool to measure important aspects of transitions. Dedicated work is necessary to translate identified phases and dimensions into indicators, and to research if datasets can for these indicators. Eventually this work indicators might result in a quantitative model. For the development of indicators cooperation will be started with other projects in research program II, and with economists (organized within the Eindhoven Centre for Innovation Studies).

The second line of research is to explore a number of themes in transition processes. For two themes projects have been defined:

1. Barriers and facilitators for the development of new transitions (project I.2). In this project the concept of national systems of innovation will be used to get a better historical understanding of options for new transitions. Differences and complementarities with the multi-level approach will be explored.
2. The role of culture in transition (project I.3). Culture is a much neglected dimension in transition theory and practice. This project will explore in-depth cultural shifts in history.

Depending on the process of further programming of research, more themes will be explored. For example:

3. The role of users in system innovations and the co-evolution of technical form and social function. Users are not simply adopters of new technologies. Technologies also have to be integrated into user contexts and daily practices. In fact, new technologies and user context co-evolve. The involvement of users in technological development is crucial because they provide feedback about how a new innovation matches their preferences, performance criteria, and other aspects of the user context.
4. The decline of existing systems. As noted by Staudenmaier (1985) and Schot (1991) The decline stage of existing systems is very seldom explicitly analysed. How do existing systems (and related companies, organizations) decline? Is it simply an economic process, in which they are out-competed? Or do incumbent actors resist, do they start lobbying with public authorities, are they compensated?

The exploration of these themes may benefit from the case-studies researched in the first line of research because some of the same cases will be studied, albeit from a different complementary perspective..

Case-studies as research strategy

This research programme uses case studies as the main research strategy. The focus is on the interlocking of multiple processes and activities, not on linear cause-and-effect relationships. Although the case studies are qualitative, they are systematic because they follow the same case study protocol. We will also explicitly complement the qualitative analyses with quantitative data. The following aspects lend themselves for quantification (and construction of indicators):

- diffusion curve (e.g. market shares over time);
- size of the markets;
- price developments of old and new technologies over time;
- price of production factors (e.g. resources, labour, capital);
- development of technical performance of artefacts over time (e.g. energy efficiency, environmental effects, speed, range).

It is important to note that the case studies are not performed for their own sake, but to develop and test analytical arguments in transition theory. We aim for analytical generalization (Yin, 1994: 36).

Case studies are a laborious method because it takes a great deal of time to collect empirical material and arrange it in plausible story lines. Because the case studies cover lengthy time periods (e.g. 40-50 years), they cannot be studied in detail. The studies are not intended primarily to unveil new historical facts, but to test hypotheses and explore new themes. Hence we will use secondary, previously published material to describe the case studies. For each transition we will look both at the leading country and the Netherlands (which as a small country often is a 'follower' or adopter of innovations which have been developed elsewhere).

Practice-oriented research projects (see proposal I.5)

Although the main contributions of the historical research programme are theoretical (the refinement of transition theory, contributions to other programmes), there are also contributions to policy, tools and practice:

1. *Regime analysis for transition domains (the past 30 years)*. Transition experiments and analysis of future transitions should be based on an analysis of path dependencies and ongoing processes in recent decades. These analyses can then be used to guide the setting up of experiments. We will seek to develop a specific tool 'regime analysis' to help practitioners to grasp the historical context of planned transition experiments and policies.

2. *Training and competence development for practitioners (e.g. policy makers, managers of transition experiments)*. The historical examples are used to illustrate transition theory, and provide material for practical exercises and competence development. A separate project will be developed to make historical case-studies useful for practitioners.

3. *Education*. Historical case-studies will be used for course development for students at universities?

Research Sub-programme II: Research of current and future transitions

Because of the as yet small and shallow knowledge of transitions and system innovations there is a need for innovative research that enhances our insights into these phenomena. This research programme aims to systematically analyse and monitor current and future transition patterns for the three selected transition domains of agriculture, mobility and health care . Using the transition concepts as described earlier an in-depth analysis will be performed of the individual transitions and underlying system innovations as well as their mutual coherence. Starting from the global research questions as introduced in 4.2.2. the following more detailed research questions will be addressed:

Research Questions

These two research hypotheses lead to the following specific research questions, both of which are theory-driven and practice-oriented:

- *Using the transition concepts within a systems framework, are we able to unravel the complex dynamics of transitions into system innovations and innovation processes at various levels in a coherent and consistent manner?*
- *Can we identify the various transition phases as used in the multi-stage concept for the current transitions that are the object of study?*
- *Can we identify and position the driving forces of transitions in terms of the multi-level concept for the current transitions that are the object of study?*
- *Can we describe the nature of change of transitions by using the multi-stage and multi-level concepts for the current transitions that are the object of study?*
- *Interlinking the two concepts of multi-stage and multi-level, can we adequately recognize, describe and explain the co-evolutionary patterns as driving forces of the current transitions that are the object of study?*
- *Using the transition concepts, are we able to recognize the seeds of changes as forebodings for future transitions? And to what extent can we project the future dynamic behaviour of transitions?*
- *Can we enrich the transition management concept with insights from related science fields such as new forms of governance: multi-level governance and reflexive governance?*
- *How can we estimate (ex-ante) and measure (ex-post) to what extent an innovative project contributes to the overall transition or system innovation sustainability goal?*
- *What are the major sources of uncertainties in the transitions considered? Which of these sources of uncertainties could be reduced and which are structural?*
- *What is the role of incremental change in the transitions studied? Can we disentangle transition dynamics into incremental change and transitional change?*
- *Are there common strategic behavioural patterns of the actors involved in transitions, and, if so, how did these strategies interact and co-evolve over time? And are we able to monitor the behaviour of the actors involved?*

Research Methodology

The research methodology consists of theoretical research starting from the three transition concepts, empirical case studies and comparative analysis. For each transition domain and for the domains as a whole fundamental research will be performed, a limited number of empirical case studies will be

carried out, and a comparative analysis, positioning the particular transition in an international context, will be conducted. The fundamental research is mainly descriptive and desk-study research, whereas the empirical case-study research is highly participatory based on the input of the stakeholders involved. The comparative study is a mixture of an analytical and a participatory approach.

Research Hypotheses

Our research hypotheses are: (i) are the concepts of multi-stage and multi-level adequate to describe and explain the currently ongoing transitions as object of study, and (ii) is the concept of transition management adequate to influence transition and system innovation processes into a sustainable direction. Obviously, with regard to future transitions this hypothesis cannot be tested, so in this case the transition concepts are used for exploratory research. In the case of current and past transitions the transition concepts are used to test the hypothesis, realizing that the hypothesis can only be tested in a partial and relative sense and that it might be adjusted during the research period.

Research Approach

Four divergent research approaches are central to this research programme. First the complex systems approach that deals with complex, adaptive systems. Second the evolutionary economics approach that deals with variation and selection mechanisms in societal innovation processes, thirdly the sociological angle, focusing on the dynamic behaviour of groups of actors in transition processes, and finally the new forms of governance, such as reflexive governance that focus on multi-level and multi-actor processes. The binding element in linking up the various disciplinary approaches is the complex systems approach: this is not used as a straightjacket, but as an over-arching framework of thinking within which other research approaches do fit (Rotmans et al., 2005).

So, following Midgley (2003), it is better to speak of "systems thinking" which encompasses a broad range of hard and soft systems approaches. Interpreted in this way such a broad systems approach allows for multidisciplinary, interdisciplinary and transdisciplinary research as was already put forward by von Bertalanffy (1950; et al., 1951). The rationale for taking the complex systems approach as umbrella for studying current and future transitions and system innovations is threefold: (i) the transition domains as our research foci could be considered as complex systems themselves; (ii) the close and recursive relation between transitions and system innovations, which makes the complex systems approach an obvious choice; and (iii) as unifying principle the complex systems approach offers a framework for synthesizing different knowledge strands which is necessary for addressing transitions and system innovations.

We define a system as a whole, which consists of a set of interrelated components (may be agents or physical or social entities) that moves into a certain direction. What a system is depends on the level at which the coherence is observed and on who the observer is. Thus three key notions are important with regard to systems: interconnectedness, perception and direction (Rotmans, 1990).

A system is complex as the system has a number of properties: (i) there are non-linear cause and effect relationships between the components; (ii) there are feedback loops in the system which may be negative (damping effect) or positive (amplifying effect); (iii) the system is open, that is energy and information are constantly being imported and exported across system boundaries; (iv) the system is nested, i.e. that the components of the system are themselves complex systems; and (v) there is emergence: some patterns emerge as a result of the patterns of relationship between the components. Furthermore, we speak of complex adaptive systems if the individual components are able to respond to changes in their environment, which implies that the system as a whole is able to adapt to changes in its environment. The environment of complex adaptive systems, however, is also made up of other complex adaptive systems, all competing for resources. This implies that a complex adaptive system is co-evolving with its environment, where both competition and co-operation are at

work. So the key characteristics of complex adaptive systems are emergence and co-evolution, which has the intriguing consequence that these systems have the ability to self-organise: for ordered patterns to emerge simply as a result of the relations and interactions among the constituent components, without any external control. When a complex system is at the edge of chaos it is in a state where these changes may occur easily and spontaneously (Holland, 1995; Kauffman, 1995). The basic denominators of complex systems are components, in system dynamics terms called stocks and flows. Stocks are components (properties) of a complex system that change relatively slowly (compared to the total volume) over a long period of time. Stocks are described in terms of quantity, quality, functionality and space-utilization. Flows are aspects that change relatively quickly in the short term and reveal the relationships between stocks. An integrated complex system is a system that integrates physical, economic and social-cultural stocks and flows.

Applying the above principles of complex systems theory to the transition domains, it is obvious that these domains are complex systems: they are either sectors (agricultural, mobility and health care), or branches (energy), or geographically determined entities (water and space utilization), each of them relatively open and nested systems with many interrelated constituent components, co-evolving with its environment and having self-organizing capability. We take the transition domains as reference systems within which subsystems are positioned such as a chain or city.

From a complex integrated systems perspective transitions and system innovations may be perceived as interwoven patterns of long-term changes in stocks, short-term fluctuations in flows, and the dynamic behaviour of agents. Transition patterns comprise social-cultural changes which occur slowly, just like ecological changes, economic changes which can take place suddenly and are usually determined by the lifespan of capital goods, and institutional and technological changes which are somewhere in between, together forming the dynamic pillars of sustainable development. The challenge is to discover under what kinds of conditions this mélange of fast and slow dynamics changes from one stage to another, and how we can influence this intricate dynamics.

Research Projects

The firstly selected series of research projects is briefly described below, split up into fundamental research and practice-oriented research projects.

Fundamental Research Projects

(i) Complex system representations and integrated process approach of the mobility system (see project proposal II.1)

Using a complex system ordering framework a system representation is designed for each transition domain, the related system innovations and the underlying innovation processes. A systemic representation of the driving forces, system changes, impacts, feedbacks, potential lock-ins and lock-outs is developed per selected transition. This systemic representation of transitions is translated into a conceptual model that contains qualitative causal relationships between stocks, flows and agents. This conceptual model representation allows for a series of experiments that yields insights into the positioning of the transition in question in terms of the phase in which the transition is, the co-evolution and emergence of processes at different levels, the nature of change of the transition phase at the different levels, and the self-organizing ability of the transition domain. This complex systems approach is combined with an integrated process approach aiming at structuring an envisioning process for sustainable mobility, involving a diverse set of stakeholders (Kemp and Rotmans, 2004).

(ii) Theoretical research into basic concepts underlying the transition theory (see project proposal II.2)

This research project aims to deepen and enrich the individual transition concepts of multi-stage and multi-level, attempting to develop a new concept for assessing the nature of change of transition patterns. It is investigated what the theoretical foundation is of the transition concepts, and particularly the search for a unifying transition concept which encompasses the above concepts is important. The overall challenge is to formulate fundamental axioms for the different dimensions of transitions (generic rules for time, space and nature).

(iii) Theoretical research into transition management from a complex systems view and new forms of governance (see project proposal II.3)

So far the concept of transition management has been largely prescriptive rather than descriptive. One way of arriving at a more descriptive manner of formulating transition management is by taking a complex systems approach, trying to unravel the different kinds of change in relation to different steering mechanisms. An ordering framework is used, based on Dirven et al., (2002), reflecting a two-dimensional ordering of transition intervention dynamics. Horizontally it distinguishes between autonomous changes and markets at the macro-level, networks at the meso-level, individual activities at the micro-level and surprises or unforeseen events which operate at all levels. Vertically it differentiates between institutions, organisations and hierarchies. By systematically analysing and specifying the relations between coordination mechanisms and steering mechanisms, more insight can be obtained into the management of the whole system.

(v) Theoretical research into the spatial aspects of transitions in relation to social interactions (see project proposal II.5)

Goal of this research is to analyse spatial planning from a transitional perspective. The emergence of large-scale spatial agglomerations, or the reverse phenomenon, 'sprawl', is a phenomenon that can be hardly explained from traditional economic theories or from social geography. The approach chosen here is to start from the micro-behaviour of agents through agent-based modelling (Moss et al., 2001). This approach underlines the interactions among agents (both individual and collective agents) and represents them in a dynamic way in a co-evolutionary process (van der Veen and Rotmans, 2001). The research has a generic character, perceiving spatial transitions as emerging processes resulting from interaction among agents. This will be applied to the mobility sector.

(vi) Empirical research into the role of human agency in transition processes (see project proposal II.6)

This research is based on the Social Practices Approach (SPA) as proposed by Beckers and Spaargaren (2002). SPA is situated in between the technological approach and the social-psychological approach, trying to connect an actor orientation with an emphasis on systemic conditions in the way products and services are delivered. This empirical approach is based on the notion of social practices and routines in the lives of citizen-consumers. On the other hand, it attempts to combine the micro-cultural factors determining human behaviour, with the regime- and macro-factors.

(vi) An evolutionary economic approach to transitions, focusing on the dynamic role and behaviour of agents in transition processes (see project proposal II.10)

To be filled in.

Practice-oriented Research projects

The practical component of the research programme on current and future transitions deals with the development of tools and instruments which can be applied in practical case-studies. Some of these

tools and instruments already exist, but even the existing tools need to be further advanced. The basic research question to be addressed is:

What tools and instruments are available or need to be developed in order to adequately initiate, stimulate, guide, effectuate and evaluate transitions and system innovations?

The existing tools and instruments are evaluated and where possible applied and, if needed, further advanced. Joint practice-oriented projects will be started with investigators of the governance sub-program, with the aim to integrate the two perspectives in a practical sensible way. Below follows a list of existing tools and instruments which could be used as supportive aid in transition and system innovation processes.

- *Transition Models (see project proposal II.2)*: both quantitative and qualitative models could be developed for describing and explaining transition and system innovation processes. Although these types of models exist abundantly, they hardly exist at the required system level. So the very idea is to develop transition-specific models for the agricultural system, transport system, energy system, the water system (van der Brugge et al., 2004) and for the spatial system.
- *Transition Scenarios (see project proposal II.7)*: although many scenarios exist for many different fields, there is a need for transition scenarios: scenarios at the systems level underlying transitions. The very idea is to develop final transition images, based upon which transition patterns will be developed, including unexpected events and surprises. Again, the transition domains will be the focus for the scenarios to be developed: scenarios for agriculture and transport.
- *A Testing Framework (see project proposal III.3)*: the goal is to develop a generic framework to test and evaluate experiments undertaken within a particular transition or system innovation. The idea is to develop criteria for assessing the (potential) contribution of innovative experiments to the overall transition goal. What is the coherence between these experiments set out? Do they reinforce or weaken each other? Are these experiments grounded in niches or not? This generic testing framework could be applied to any of the current transition domains, but also to future transition domains.
- *Actor Analysis Tool (see project proposal II.9)*: the goal is to develop an actor-oriented tool with which major actors could be mapped and niche actors identified, and the different roles in different phases of the transition could be traced, and the new working modes for these actors could be further explored. Some actor-oriented tools are already available, such as the TRINITY method (Diepenmaat, 1997), which, however, are not specific for transitions and system innovations, but could serve as a basis for developing transition-specific actor tools.
- *Integrated Monitoring instrument (see project proposal II.9)*: the overall goal is to develop a monitoring instrument which allows the monitoring of current and future transition and system innovation processes. This requires a different monitoring method than the traditional monitoring instruments. We need to monitor undercurrents, weak signals and niche developments, rather than mainstream developments which are clearly visible. This has implications for the basic indicators of such a monitoring system, which need to be based on stocks rather than on flows, and on actor dynamics and process dynamics.

Research Sub-programme III: Governance of transitions and system innovations

New modes of governance are necessary in order to influence the development towards a more sustainable society. This new type of governance has to be more anticipatory (by assessing risks and opportunities for improvement) and participatory; “governance of sustainable development goes well beyond traditional, state-centred policy-making because it aims at pro-active changes of individual actors’ and firms’ behaviours at different levels.” (Bleischwitz, 2003:5). As a multi-dimensional and dynamic concept sustainable development can thus neither be translated into the narrow terms of static optimisation nor is it adaptable to strategies based on direct control, fixed goals and predictability (Rammel, Hinterberg and Bechthold, 2004, p. 1). Learning and innovation should therefore be important aspects of sustainability policy. An integrative and reflexive approach towards sustainability implies shifting the focus away from partial optimisation and towards system innovations or fundamental transformation processes to attain fundamental societal goals. Whilst this is accepted in the discourse on sustainable development, policy is still poorly oriented to fundamental transformation processes. This is why the perspective of transition management is important: it offers a model for policy integration and more generally for governance, *the structured ways and means in which the divergent preferences of inter-dependent actors are translated into policy choices to allocate values, so that the plurality of interests is transformed into co-ordinated action and the compliance of actors is achieved.* (Eising & Kohler-Koch 1999: 5). Through governance structure interdependencies are ‘managed’. The perspective of system innovations, understood as reflexive modernisation, provides a more specific orientation to governance. It draws attention to the fact that much literature on governance, while emphasizing the idea of creating interactive, less top-down approaches to government neglect the ways in which government, the market, science and civil society *have* interacted and co-evolved. Thus this perspective helps to understand that a much more profound transformation of these institutions and their alignment is needed than merely a change in the mode of government. By orienting governance structures to transitions greater benefits through system innovation may be achieved (Rotmans et al., 2000; Geels & Kemp, 2000; Rotmans & Kemp, 2002). Transitions bring about structural and institutional changes that influence the market, innovation and political-administrative systems which need to be governed into a sustainable direction. Transition management comprehends three different processes: (i) *defining sustainable system innovations*, (ii) *instigating, linking up to and maintaining long-term dynamics*; and (iii) *breaking the current regime*.

This governance research programme therefore contains two research dimensions: the research of transition management and its underlying components [sustainable system innovation, long-term innovation process and regime analysis], and research of the three system components which determine institutional dynamics towards the sustainability transitions: the economic system, the innovation system and the political-administrative system. This is depicted in Figure 3, which describes a conceptual framework that might depict a transition as a result of the complex, dynamic and subtle interplay within and across four groups of stakeholders: governments, companies, knowledge institutions and NGOs / citizens. The overarching framework distinguishes ten types of interactions between the stakeholder groups (van Witteloostuijn, 2002a).

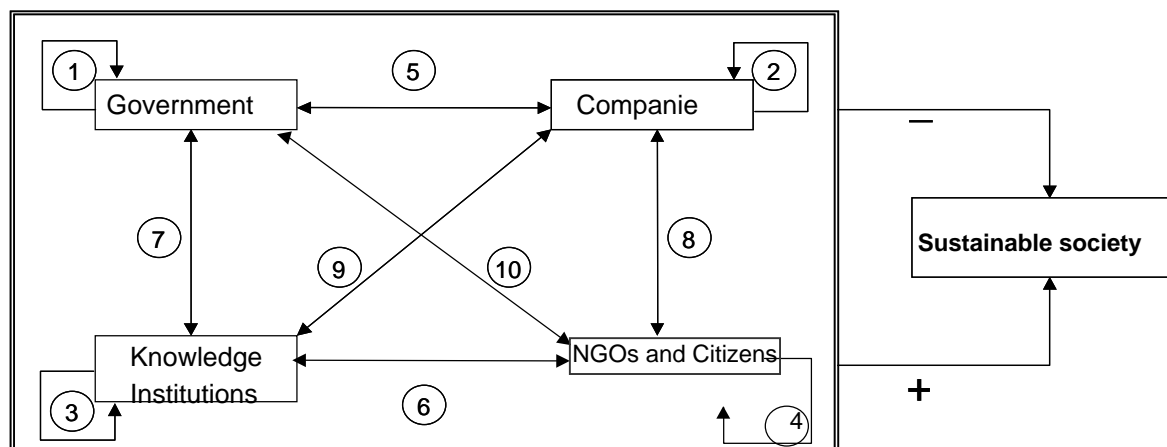


Figure 3: A ten-interaction framework of interactions among stakeholder groups

Rather than investigating each individual relationship in Figure 3 we aim to explore clusters of relations between the actors involved, thus doing justice to the complexity and the interconnectedness of reality, and to the fact that transition and system innovation projects tend to be located in between the existing institutions. The market system comprises those relations in and around companies (relations 2,5,8 and 9 in Figure 3), the innovation system includes the relations in and around knowledge institutions (relations 3,6,7, and 9 in Figure 3), whereas the political-administrative system embraces the government-departing relations (relations 1,5,7 and 10). We will investigate each of these systems with particular attention for i) the relations to the other systems and ii) trans-national influences.

Both lines run in parallel, where a major focus is on the integration of both research lines. In order to do this, we make use of knowledge and insights from innovation studies, economics, political science, policy analysis and historical case studies to analyse the processes and institutions to be governed. *The main objective is to contribute to the further development of the notion of governance and elaborating these insights into practical guidelines for transition management.*

Within this context, and taking the research questions as introduced in 4.2.2. as the starting point, the following research questions will be addressed:

- *What are effective instruments for governing transitions and system innovations? Could we develop an adequate mixture between existing instruments and new, innovative instruments?*
- *How to define and develop an inherently normative and intrusive concept such as sustainable system innovation in a legitimate way, within a context of a plural society in which there is no single sovereign actor?*
- *How to deal with the challenge of democratically legitimate, long-term planning as part of a transition or system innovation process?*
- *How to bring about and maintain long-run system change in interconnected systems, under conditions of fragmentation and trans-nationalisation? What does this imply for practices of policy analysis?*
- *How can the answers to the above questions be integrated into an adequate, generic concept transition management, rooted in concepts as multi-level governance and adaptive management?*

Research line 1: themes in transition management

This research line includes three research components: sustainable system innovation, long-term innovation processes and regime analysis. By its nature, fundamental/theoretical research on governance is closely related to the practice of governance. Thus in many cases projects will consist of a fundamental part and a practice-oriented part, where a cross-domain comparative reflection on the findings of fundamental/theoretical projects will yield recommendations and competences for practitioners.

Sustainable system innovation

Sustainable system innovation inherently involves a normative orientation, so it must be defined contextually through deliberation (Hoppe, 1998; Grin, 2004; Teisman & Edelenbos, 2002, Rotmans et al., 2000). Defining sustainable system innovation is far from trivial and further investigation is of both analytical and practical interest.

Policy-making arrangements, knowledge institutions and the knowledge they produce have co-evolved with broader societal development. Such reflexive deliberation will often raise knowledge needs that are hardly covered by the dominant paradigms within the knowledge infrastructure, and may imply a need to synthesize universal, scientific knowledge with local knowledge (Grin, 2005). In these cases the definition of sustainable system innovation will require a so-called Mode II or transdisciplinary knowledge production. And finally, while the practices of knowledge production referred to above have a crucial impact on social development, the democratic legitimacy of such institutional niches is not trivial (Teisman & Edelenbos 2002). This all leads to the following research questions:

- *What types of institutional arrangements and methods are appropriate for defining sustainable system innovation? And what is the role of knowledge production in defining sustainable system innovation? See project proposals III.1 and III.2.*
- *What kind of institutional barriers do we need to overcome, and how can this be realized to make sustainable system innovation happen in practice? And to what extent does this reflect the guidelines of 'deliberative democracy'?*
- *To what extent and in what ways do practices for knowledge production take into account the values and world views of the variety of stakeholders involved in sustainable system innovation? See project proposal III.7.*

Bringing about and maintaining long term change

Transitions and system innovations, by their very nature, concern normatively oriented innovations that go deep and require a long time horizon. This introduces the need to deal with the temptation of comprehensive planning as well as the need to deal with the accountability dilemma (March & Olsen, 1995): accountability to short term concerns seems to hamper opportunities to maintain a long-run perspective. Several bodies of literature may be of interest. Insights from sociology (e.g. Giddens, 1984; Bourdieu 1992; Goudsblom, 1992), from innovation technology science (e.g. Constant, 1980; Hughes, 1987; Callon, 1992, Christensen, 1997), literature on incrementalism (e.g. Lindblom, 1959; Etzioni, 1967; Hoppe, 1983; Lindblom & Woodhouse, 1993; Grunwald, 1999) and learning (e.g. Sabatier & Jenkins-Smith, 1993; Rein & Schön, 1994; Grin & van de Graaf, 1996) may help to further develop new modes of governance, taking account of multiple actors, multiple levels and multiple time scales. What is needed is a re-consideration of this literature from the perspective of sustainable system innovation, and a synthesis between these bodies of literature. Research questions derived from this are:

- *What can each of the above bodies of literature contribute towards a better understanding of the new modes of governance that need to be developed for transitions and system innovations?*
- *In what way(s) can these insights be synthesized in such a way that new modes of governance in the line of transition management can be developed and applied in practice?*

- *To what extent are the notions of 'strategic niche management' and 'bounded social experiments' useful instruments for new modes of governance in the line of transition management? See project proposals III.3.3.*

Breaking the existing regime

Destabilising the existing regime can largely be done by the classical policy instruments on which a vast body of literature exists (Bressers & Klok, 1987; Hufen, 1990; Pröpper & Herweijer, 1992; WRR, 1992; Vermeulen 1992; Bressers et al., 1993). They may make established ways of action impossible or much less attractive, they may induce learning or they may have a structural impact. Sunk costs and vested interests are important stabilising factors, but another important stabilising element of regimes are the shared assumptions within a regime: the consensus about problems and approaches to solving them in the case of technological regimes, and the consensus about institutional ways of dealing with issues in the case of policy regimes. Assumptions may be challenged by outsiders in societal discourses organised in advocacy coalitions, or by insiders who may come to accept a new guiding principle, such as integrated water management. The credibility of the solutions depends on the credibility of the propagator and evidence that the solution is viable. This suggests that there are two ways of changing regimes: deliberation and experiments with new solutions, combined with the exercise of power. Further research is needed on the following questions:

- *How do regimes respond to tension? Under what conditions do innovative responses occur?*
- *To what extent are regime changes the result of top-down and bottom-up processes? And what is the role of niche developments in regime changes? What are the implications when niches correspond to multiple regimes?*
- *Does reflexive governance offer a useful model for bringing about regime changes, and what does this mean?*
- *How to deal with short-term economic realities of transition costs and the need to satisfy shareholders?*
- *Are expectations a useful entrance point for intervention?*
- *What multilevel changes in governance are needed in a globalising world? Policies aimed at changing technological regime policies tend to be national; what about international policies and trade rules? Does the world trade rules harm national regime policies? How to deal with this?*

Research approach and method for the first research line

For quite a few of the above formulated research issues it is still too early to formulate research hypotheses. Therefore, an explorative, theory generating method (Glaser & Strauss, 1967) will be combined with a theory testing a refinement, following Yin's (1987) method of theoretical replication within and across domains. Additionally, some action research will be done, in which insights may be tested and developed by translating them into advice in monitoring/evaluating/advising practice experiments. Data sources will be the historical data base as developed within the research line on historical transitions, case studies of previous system innovation projects done by the participating groups and the monitoring of concurrent projects.

Projects will be undertaken on each of the three themes identified above, projects in which expertise from several disciplines will be integrated, of which we give two examples. First a project that analyses projects for sustainable system innovation in terms of *the institutional arrangements and methodical rules defining system innovation and the impact of the existing regime on the design practice and the relation of the knowledge needs implied by the design with the existing knowledge infrastructure?* (see project proposal III.2). And second, a project that analyses the ways in and conditions under which a particular project may induce system innovation in a wider environment, addressing questions such as: how to 'design', develop, organize, monitor and evaluate socio-technical experiments in order to facilitate and induce higher order learning on sustainability? How

may individual experiments add up to niches? How can processes of niche development contribute to system innovation, i.e. how do niches influence regimes? See *umbrella proposal III.0, as well as underlying proposals III.1 - III.3.*

These projects are, in principle, fundamental and theoretical research projects. Due to the nature of research into governance, however, it is sometimes a small step from the findings of such FTP research towards competences for practitioners involved in transition management. In such cases, and especially in those cases in which cross-domain comparison is done, a practice-oriented research component may be added into the projects if this appears to be the most direct and efficient way to translate fundamental findings into competences for practitioners.

Insights gained from individual projects will be synthesized in a theoretical meta-project to be undertaken early in the final year of the research. This synthesis will incorporate insights from the other two sub-programmes and, conversely, findings from the governance sub-programme will feed into integrative projects in the other two. They will be translated into competences in cross-domain, practice-oriented projects. Here too, cooperation with the two other sub-programmes will be sought, especially during the final two years of the proposed programme.

Research line 2: Analysing co-evolving systems

The market system

This research focuses on the influence of globalisation and on societal sustainability entrepreneurship. While there is extensive literature on globalisation, the implications for the transition to sustainable development still need further study. (Mol, 2001; Van Seters, 2003). Two mechanisms are particularly important in bring about these implications. First, several authors (e.g. Castells, 1996; Giddens, 1991) have indicated that globalisation together with individualisation are the main drivers of changing consumption patterns (Spaargaren, 2003) as well as on decreasing trust of citizen-consumers in traditional governmental and economic players (see e.g. the consequences of the GMO debate and the livestock crises of the 1990s). Further study of the relation between changes in consumption patterns and transition, under the influence of globalisation, is highly needed. Second, globalisation together with technological development has an influence on economic relations, giving rise to changes in existing, as well as new, institutional arrangements within the market as well as between the market. Important examples are concentration and integration of economic chains and scale enlargement; and changing relations between North and South. The implications of these developments in terms of barriers and opportunities for the transition to a sustainable development needs further study. (Den Butter & Hofkes, 2005) Sustainable entrepreneurship (Carroll, 1999; Van Tulder & De Zwart, 2003), defined as path-breaking activities that emerge from the interplay between different stakeholders with the active involvement of the business world, is needed to strategically deal with these developments in and around the market. Developing more insight in the relationship between such strategic action by economic actors on the one hand, and their environment is of crucial importance. This includes better insight in partnerships between economic players, NGOs and knowledge workers and the institutional arrangements in which these may be embedded (Rowley, 1997; Freeman, 1999; Cramer, 2001; Maessen *et al.*, forthcoming).

The following research questions are important here:

- *Which globalisation trends are now relevant for the domains of agriculture and mobility? What problems and what opportunities do they imply for sustainable development in these domains?*
- *What can societal sustainability entrepreneurship contribute to dealing with globalisation in a more sustainable way?*

- *How do shifts in consumption patterns occur under influence of globalisation? To what extent, in what ways do they relate to changes in supply?*
- *To what extent do shifts in demand support or complicate system innovations that may contribute to the transition to a sustainable society? What new arrangements may contribute to dealing with the challenge of adequately dealing with these shifts?*
- *What barriers and what opportunities are implied by the impact of globalisation on markets, especially in the agrofood domain, and on transportation?*
- *How can transition processes be stimulated by promoting societal sustainability entrepreneurship so as to adequately deal with the implications of globalisation?*
- *Which incentive structures can be put in place to stimulate and facilitate societal entrepreneurship within a corporate governance structure, within the market and between the market, government, science and civil society??*
- *What can new types of partnership and competition contribute to transitions and system innovations?*

The innovation system

The production and application of knowledge plays an important role in transition processes. There is an important relation between the content of knowledge and the way in which knowledge production is embedded in our society. The heuristic concept of the innovation system can help us to understand the mutual relation between knowledge production and transitions of (parts of) our society. The main idea behind this concept is that gains from investing in the development of knowledge are to a large extent determined by the way in which knowledge production is organised and embedded in societal and economic processes and systems. (Freeman, 1987; Nelson, 1993). Innovation systems extend over schools, universities, research institutions (education and science system), industrial enterprises (economic system), the politico-administrative and intermediary authorities (political system) as well as the formal and informal networks of the actors of these institutions. Insight into the functioning and the development of innovation systems is important because they embody the interface between the production and the use of knowledge in our society. Innovation systems often go through complex transition processes themselves. (Schumpeter 1934; Rosenberg, 1976; Freeman, 1987; Lundvall, 1988; Nelson, 1993) and are increasingly taking place at the system level (Smits & Kuhlman, 2002). Major research issues here are:

- *What are the consequences of the transition of the innovation system from Mode I to Mode II for the knowledge institutions, their missions and institutional features?*
- *How do practical system innovation projects deal with the co-evolutionary development of techno-economic and socio-institutional transition processes? How are the different types of learning organized?*
- *How do different types of more horizontal types of governance of innovation systems in various European countries compare? To what extent do they facilitate cross-sectoral linkages and the support of cross-sectoral networks?*
- *How to balance support and selection pressure?*
- *What role is there for generic instruments aimed at changing the general frame conditions?*

Second, a new type of policy instruments has recently emerged, tailored to sustainable system innovation: so-called systemic instruments. The emergence of such instruments is rooted in changes in the nature of innovation processes and systems, as well as theoretical and practical insights how to influence them that all point to an increasing systemic nature of innovation (Smits & Kuhlman, 2002). Examples of such instruments are the programs pursued by organizations like the Agency for Sustainable Technology Development and other practice organizations. Systemic instruments are targeted at making the innovation system more friendly to desired innovations. Important functions

are: building and organizing innovation systems, providing a platform for learning and experimenting, providing an infrastructure for strategic intelligence, and stimulating demand articulation, strategy and vision development. Research questions here are (see project proposal III.6):

- *What systemic instruments exist in the international dimension, what functions are they to fulfil and in which situations are they being applied?*
- *How are systemic instruments employed by practice organizations used? How can this use be evaluated, particularly in terms of: intended and unintended impacts; inducement / facilitation of learning; contribution to creative destruction?*
- *What are the relative contributions of and mutual interference between systemic instruments and classical instruments? How to initiate the development and application of new systemic instruments?*

Political-administrative institutions

Like in the market and innovation system, also in the public sector an organisation's performance no longer only depends merely on its own functioning but also on the quality of the total chain and the capacity to join forces in realising high-quality products and innovations. Yet, since political-administrative institutions have co-evolved with other institutions around classical problem definitions, the institutionalised division of tasks between and within different governmental levels, as well as the relation between government, civil society and the market may not be optimally suited for dealing with the challenge of sustainable system innovation.

This discrepancy between the nature of network society and the nature of existing institutions has led to several new types of policy making: 'chain approach' (Lee and Billington, 1993; Duivenbode, et al., 2000); process management (De Bruijn et al, 1999; Teisman & Edelenbos, 2002), network management (De Bruijn & Ten Heuvelhof, 1995; Kickert et al., 1997) and interactive policy making (Hendriks & Tops, 2001). See project proposal III.5.

On the other hand, various processes of organizational and substantive renewal of environmental policy have been and are taking place and lead to new policy arrangements (Van Tatenhove et al., 2000). See project proposal III.10.

Important research issues here are:

- *To what extent and in what ways do existing functional differentiations between government and society, as well as within government (departmentalisation) contribute to sustainable transitions and system innovation? What kinds of institutional or procedural remedies can be envisaged?*
- *To what extent and in what ways are new approaches to governance adequately institutionally embedded? What kinds of institutional remedies may be envisaged?*
- *What institutional developments are under way in environmentally relevant policy areas, to what substantive developments do they relate? What problems and opportunities do they present for sustainable system innovation?*

Research approach and method for the second research subline

Similar to Research subline 1, the projects are in principle fundamental/theoretical by nature, but may, under certain circumstances, include a practice-oriented component. Like in Research subline 1, a combination of theory generating and theory testing/refining methods will be used. In addition, science-practice partnership and action science (Argyris et al., 1985) will be frequently practiced. Finally, in practice-oriented research projects the so-called policy laboratory tool will be used for discussing the findings of ex-post research as well as to generate improvements for the future. In the Policy Laboratory interactive and participatory instruments, as well as the knowledge to apply them, are brought together so as to create an optimal environment for learning. (Smits & Geurts, 1997, Glasbergen & Smits, 2002). Also, a major joint practice-oriented project will be sought with

investigators from the second sub-program, integrating insights on complex system dynamics with insights on the three systems gained from this research line.

4.3 The Interaction between Research and Practice

4.3.1 Linking Research and Practice

An essential aspect of the KSI Knowledge Project is the dynamic interaction between knowledge development and actual practice, which is described in detail in sections 3.4.1 and 3.4.2. This section describes the content of Testing Grounds (Integrated Projects)

4.3.2 Practice-Oriented Research

Generally speaking, practice-oriented research comprises three components. *First*, within the KSI network, a knowledge base concerning of former and ongoing transitions and system innovations will be built which allows a mutual comparison to be made of the various forms of transitions and system innovations, in terms of process architecture, cross-domain characteristics, transition experiments in use, learning experiences from the transition experiments, etc. The *second* component concerns the development of instruments for the management of transitions and system innovations. These instruments are developed within the FTP programme based on research into ongoing and former transitions and system innovations. Examples of these instruments are a monitoring system for transitions, an uncertainty management system, a database for historical transitions, an evaluation framework for transition experiments, and a scenario generator to develop transition scenarios. And finally, there is a competence base in development that provides insight into what kind of competencies, in what phases, and what kinds of person are needed. Both the knowledge base and the competence base can be employed very specifically to meet the needs of actual practice. Also, the Testing Grounds (Integrated Projects) can help broaden the knowledge and competence base by answering specific questions from actual practice.

By taking part in practice-oriented research, practice organizations gain access to well-founded knowledge and competence concerning transition and system innovation. Furthermore, they can make use of a developed set of instruments for transition and system innovation. The experiences of practice organizations also serve as an important source of knowledge for these instruments. Accurately relating the needs of practice on the one hand, and the findings of research and the competences to be derived from the, on the other, requires interaction between researchers and practitioners. In order to adequately identify the right 'partnerships' between researchers and practitioners, to structure these processes of interaction, and to bridge the differences in language an interface will be created with specialist who master the art of 'broking' between research and practice. This interface function will be fulfilled by the Competence Centre for Transitions, a strategic co-operation has achieved between KSI and the Ministry of VROM, NOVEM and TNO. The co-operation agreement has been added as Appendix 1; the CCT will be further discussed in chapter 8.

4.3.3 Testing Grounds (Integrated Projects)

Testing Grounds (Integrated Projects) are practical experiments within practice programmes, in which a number of relevant stakeholders — private and public — will work together to contribute innovatively to solving persistent and complex social problems in specific sectors at system level. Using these Testing Grounds (Integrated Projects), the practice programs can go to work in real-life situations. Their work must give rise to new behavioural perspectives among the stakeholders involved. Within these Testing Grounds (Integrated Projects), a variety of knowledge forms —

whether explicit or experiential — coalesce to a degree, this will be the result of the fact that, in the Testing Ground (Integrated Projects), a variety of social parties operate together. Furthermore, different scientific disciplines will cooperate in an interdisciplinary environment.

The practice organizations of Transforum and Transumo that have worked on these project plans wish to make use of KSI's knowledge and competencies within the Testing Grounds (Integrated Project). On the other hand, Transforum and Transumo wish to make their Testing Grounds (Integrated Projects) available to bring new knowledge about transition and system innovation to light. This involves experimentation, or a cluster of experiments, of sufficient scale and participation in order to contribute to system innovation.

In the first instance, KSI will focus on Testing Grounds (Integrated Projects) in the fields of sustainable agriculture and sustainable mobility in close cooperation with Transforum and Transumo. Meanwhile the door is open to participate in Testing Ground (Integrated Projects) for other domains, such as multiple space utilization, construction sector, water management and energy use. With regard to sustainable agriculture and mobility six Testing Grounds (Integrated Projects) have been defined: three for sustainable agriculture and three for sustainable mobility.

The co-operative agreement between KSI, Transforum and Transumo – which includes a tentative list of potential IPs - is included as Appendix 4. Decisions on the final selection of IPs and some other general matters will be taken in the first half of 2005 by KSI, Transforum and Transumo. The precise definition of these projects will be a first major activity in these projects, and the major focus of 2005. The way in which KSI sees its involvement in these IPs will be discussed further in chapter 8. The Competence Centre for Transitions (CCT) will play an important role as intermediary organisation between KSI and the application and implementation of KSI-tools and instruments in Testing Grounds (Integrated Projects), see also Chapter 8.

5 Socioeconomic Relevance

5.1 The Relevance of System Innovations for Dutch Society

The general relevance of the KSI Knowledge Project relates directly to the observation that a number of persistent problems have arisen in our society as a result of flaws that only can be solved at a systemic level. Energy infrastructure, agriculture, water management, space utilization, the traffic system, and the health care system are all examples of where people have been working for too long within institutional settings and systems that do not match present day needs any more. If the transition to sustainability were to take place in a society with stabilized roles and power structures, we would have a guideline as to the way other broad issues were regulated. In the present situation, however, sustainable development has to be fitted into social relations that are themselves in motion. The shift in the balance of power between states, firms, and households, and the associated changing social attitudes toward the responsibilities held by firms and other actors require that new solution strategies are needed. KSI intends to provide the knowledge necessary to develop these new strategies.

KSI responds to the government's recent NMP4 and National Strategy for Sustainable Development geared toward transitions to sustainable development. The key challenge is to meet existing human needs in an entirely new and sustainable manner, which requires far-reaching social changes affecting every sector and all sections of society in the short as well as long term. It is impossible to make a reliable quantitative estimate of the government's transition policy socioeconomic impact. To do so would contradict the interactive programming approach and collective process used in formulating objectives and priorities — by definition, the outcome and related yields cannot be accurately predicted at this point in time. By definition transition processes are search and learning processes with a highly uncertain outcome. However, it is possible to describe KSI results for business, governments and society as a whole in a qualitative sense (section 5.5.1). This paragraph will examine in greater detail the necessary tools (section 5.5.2) and key competencies (section 5.5.3) employed by KSI to make a substantial contribution to transition policy.

The chronic damage as a result of a poorly functioning system (mobility, health care), the looming severe damage in systems that cannot sufficiently respond to massive disruptions (water management, livestock) and the damage in sectors where economic activities interfere with one another (caused by inefficient spatial planning, for example) annually range from hundreds of millions to billions of euros. Making sure systems evolve in time can reduce damage, whether real or potential and, more importantly, create new impulses for investment and activity.

Sustainability is a global issue. It can be viewed as a challenge but also as an opportunity. Through this Knowledge Project, Dutch businesses and Dutch society as a whole acquire the competence to incorporate sustainability considerations effectively in their operational and decision-making processes. In this way they gain a sustainable comparative advantage over countries where sustainability measures have to be retrofitted onto inadequate systems.

5.2 The Challenge Facing KSI

Countless parties in many sectors are facing the question of how to achieve 'sustainability.' The important thing is to avoid everyone individually determining how to achieve sustainability, which would take far too long and increases the risk of failure and delay. Individual sectors have difficulty in looking beyond their borders and assessing the value of what is taking place elsewhere and applying these experiences and knowledge, scientifically derived and validated and in a generalized form.

Explicitly defining and sharing knowledge and experience should vastly improve the speed and quality of efforts aimed at achieving sustainability.

The challenge is to elevate all available knowledge and experience, no matter how delineated it may be, to a higher level and to make it accessible to all organizations involved in or planning on tackling system innovations. The prevailing atmosphere of doubt and trial and error must give way to an active *community* where diverse organizations go about improving 'their' system using a collective, deliberate and focused approach. Only then will investment in fundamental knowledge actually prove profitable and a group will emerge comprising individuals who represent dozens of positions in countless organizations. This group is marked by a mutual desire to make society more sustainable. These individuals have the experience, knowledge and tested tools to professionally rise to the challenge.

5.3 Legitimising the Bsik Contribution

The demand for knowledge about transitions and transition management by definition stems from questions existing in society. These questions always arise from the desire to solve a complex, persistent problem or the wish to collectively jump onto a promising development trajectory. Answers to such questions never come from the increasingly differentiated and specialized scientific disciplines, such as policy studies and economics. Instead, they must be sought by combining and integrating knowledge areas and through intensive interaction between theory and practice.

Therefore, a knowledge infrastructure must be achieved based on three pillars:

- Fundamental knowledge about transitions, or about how they can be influenced and directed.
- A mechanism to link fundamental research on transitions with actual practice in order to stimulate the diffusion of knowledge-guiding transitions and to acquire feedback on the directions the fundamental research programme should take.
- Contributing to the development of a critical mass of actors in our society with the necessary competences to professionally facilitate transitions and system innovations.

The transition to sustainable development is of national and international interest and requires a broad combination of competences, expertise and investments. The various players involved, state authorities, the national and international business world, citizens, NGOs, and science all have their own responsibility in contributing to this process. So far, competency development geared toward advancing processes to attain a sustainable society in a deliberate, explicit way, supported by fundamental research spanning multiple sectors, does not exist anywhere in the Netherlands. The only way to initiate these processes is by bridging the gaps between various fields and institutes within the knowledge infrastructure.

The characteristics of Bsik (a combination of fundamental knowledge and practice, broad scope, the variety of actors involved, the long-term orientation) makes that, apart from Bsik, there is no policy tool that fits in with the aim and approach of this Knowledge Project. The traditional financing instruments are not adequate when it comes to supporting trans-disciplinary, fundamental knowledge development in interaction with practice projects. Networking instruments undervalue the necessary knowledge development. A contribution by Bsik is the only way to provide the needed impulse now.

5.4 Why Other Approaches Fail

There are three possible alternatives to this Knowledge Project:

- *Alternative 1: Carry on with only the practice projects.*

Practice programmes appear to require broad scientific support and foundations. Using this alternative, the vital connection to scientific research would take shape slowly and loosely, and as such the desired competency distribution and transfer would falter.

- *Alternative 2: Carry on with only the scientific research.*

The existing knowledge infrastructure for sustainability has been organized mainly around questions in which economic and social progress predominate. As such, there is a distinct lack of inter-disciplinary and trans-disciplinary interaction, which is crucial for arriving at fundamental transition knowledge. The link to practice is in fact what helps gear transition knowledge toward applications in society.

- *Alternative 3: No support from ICES/KIS*

This alternative suggests realizing cooperation with own means. Without help from ICES/KIS, the Knowledge Project would rely heavily on the market for funding, but they would certainly not invest in the development of fundamental transition knowledge. They would be only interested in short-term yields, which could be directly used in the production process.

The Consortium participants conclude that these alternatives have significant disadvantages or would not work at all, especially since the crucial link between fundamental research and practice either fails to materialize or takes much too long, and because the desired knowledge and competency exchange fails to occur to any significant degree, if it all.

5.5 Socio-Economic results

5.5.1 Socio-economic Impact

The most substantial KSI results appear in three forms, which can be summarized as:

- For society as a whole: reduce / prevent system errors and create new opportunities for the development of welfare and prosperity.
- For governments: an effective set of tools for transition management and monitoring;
- For business: constant opportunities to gain a leading edge in moving toward sustainability. This means shorter time to market for innovative business opportunities;

The following provides a more detailed analysis of each form.

Impulse for Growth of Welfare and Prosperity in our Society

The transition policy aims to make progress in dealing with persistent problems that environmental policy has yet to find any acceptable solutions for, such as the changing climate, increasing mobility, water management, loss of biodiversity and natural resource overexploitation. None of the persistent environmental problems can be classified as an isolated problem; each relates to a number of policy areas, and therefore in order to make any progress it is crucial to align these policy areas more effectively. In the NMP4, the Cabinet noted that the advancement or intensification of current policy will not bring about adequate solutions and pointed out that system errors in the current social classification stand in the way of sustainable solutions. The ambitious answer is policy modernization. The NMP4 strives to eliminate any obstacles using integral policy under the banner 'system innovations to sustainability'. The recent emphasis on the knowledge economy and innovation, as can be seen from the establishment of the innovation platform, furthermore underlines the crucial role of knowledge and innovation in the transition to a truly sustainable society of our modern societies.

The above indicates that the knowledge, methods and skills to be developed in KSI are indispensable for effective and justifiable transition policy. Various studies show that transition policy failing to materialize or missing the mark can have disastrous consequences for society:

- The climate continues changing, which has dire consequences in terms of safety, health, prosperity and welfare for millions of people in the Netherlands - as well as the rest of the world;
- Mobility continues to increase within the heavily urbanized Netherlands, which leads to a standstill in cargo transport, which is a key component of our retail-based economy, and makes our cities unliveable and inaccessible cities.
- The reorientation of our agricultural sector stagnates, which rapidly marginalizes our competitive position compared to other EU Member States and the US. Losses are two-fold: farmers lose their source of income and the Dutch landscape loses its characteristic traits.
- The water problem continues to cause enormous damage, both in terms of coastal zone damage due to sea level rise, and floods of the major rivers the Rhine and the Meuse.

Even without detailed quantification these four examples illustrate how ignoring the continued existence of 'system errors' will cost our society billions of euros in damages.

The knowledge and competencies developed in KSI not only help prevent damage but also create new opportunities for additional welfare and well-being. There are two aspects of relevance here:

- First, system innovations are directed first and foremost at developing new processes, products and systems to meet existing human needs in a sustainable manner. Knowledge institutes, businesses, governments and social stakeholders work together actively to develop new and innovative concepts, which are economically profitable for business ('profit'), acceptable to social stakeholders ('people') and do not have any adverse effect on environmental quality ('planet'). On the other hand, corporations incapable of responding to the constantly changing requirements and expectations of globalizing civil society lose strategic fit and international competitive market position.
- Second, the expansive composition of transition arenas offers new opportunities. These arenas extend beyond the traditional boundaries between sectors and social institutions, joining knowledge and experience that had never before been combined. What is true for companies, also holds for nations. Nations that cannot respond to a constantly changing world lose their competitive position

Effective Government Policy

The Dutch government has limited experience with long-term policy and the implementation of transition trajectories. Besides, also the knowledge required to adequately evaluate the effectiveness of a long-term government policy is lacking. Experience is gained from a number of transition experiments to be sure, but the current structure of these experiments prevents gaining thorough insight into the government's role, tools and effectiveness. The KSI knowledge project makes a substantial contribution to government transition policy effectiveness by providing new knowledge on the drivers, mechanisms and preconditions that make or break transition initiation, furthering and continuance. This new knowledge is indispensable for effective policy instrumentation.

The government decided to use transition policy to stimulate change processes to achieve sustainability on a long-term basis. This policy must be based on thorough insight into the characteristics and dynamics of transitions in order to prove to be successful. That insight is precisely what is still lacking. KSI makes a considerable contribution to developing and testing knowledge about the drivers, mechanisms and preconditions that make or break transition activation and continuance. KSI uses this new knowledge to lay the foundation for effective policy instrumentation.

Furthermore, the Knowledge Project KSI produces the tools to measure transition policy effectiveness. It is difficult to quantify the result in socioeconomic indicators. However, we can see that the current trend is to make government spending decisions increasingly dependent on how well intended policy effects can be measured and what added value they represent. In that sense, we can expect that transition policy lacking any scientific base and adequate monitoring will quickly lose its legitimacy.

Strong Competitive Position for Dutch Business

The KSI Knowledge Project capitalizes on the pursuit of *leading, internationally operating companies* to increase the eco-efficiency of products and services⁶: “Companies become eco-efficient through the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth’s estimated carrying capacity”.

At an international level, businesses are being called upon to account for the sustainability of their processes and products. Businesses that have integrated sustainability issues structurally into their operations will always gain the upper hand. The idea is *societal sustainability entrepreneurship* that pays attention to Profit, Planet and People. An increasing number of companies also realizes that sustainable innovation can generate appealing benefits. Several leaders already demonstrate concrete proof of success. In their experience, sustainable innovation paves the way to new, challenging business opportunities in an international market demanding increasingly higher quality.

Active participation in the KSI project will strengthen the Dutch business sector’s ability to innovate quickly in a sustainable and need-oriented manner in a market where achieving a balance among people, planet and profit proves increasingly more important for business continuity. In order to quantify this result indicatively, we would be best advised to look at the annual R&D investments in the relevant chemical, energy, agro-food, manufacturing and service sectors. A modest efficiency increase equal to a small percentage of the annual investment ranging from several hundred millions to a billion euros would easily justify the requested investment in the Knowledge Project under consideration.

5.5.2 Key Competencies

Competencies are combinations of knowledge, skills and attitude required by actors to play an active role in stimulating and managing transitions. They are indispensable to realize the yields mentioned in the previous section. Key competencies are typically connected to the practice of transitions and individuals involved. When multiple individuals within a single organization possess these competencies or complement one another to form a team characterized by competencies, then the organization itself also possesses the competency. The working procedures, organization culture and informal network within the organization can serve to reinforce competencies. People are always the vectors of competencies. Transition success correlates directly with the level of competency. Therefore, the higher the competency level, the smoother transitions proceed and the higher the socioeconomic yields.

Based on the expertise acquired by practice organizations during the past years, an initial description of the competencies required for transitions has been established. The description refers to the *key competencies*. In the Knowledge Project KSI, carrying out projects, acquiring scientific and other types of knowledge and being able to possess a growing number of tools helps to develop and

⁶ World Business Council for Sustainable Development

reinforce these key competencies among individuals. Moreover, in the course of the Knowledge Project implementation, the *number* of people with these key competencies increases, and consequently increases the *number of organizations* where these individuals can actively apply their talents.

So far, key competencies have been identified with regard to (i) the ability to play an initiating role in the early stage of a transition; (ii) the ability to design a process architecture for transitions or system innovations; (iii) the ability to successfully implement a transition or system innovation trajectory; (iv) the ability to translate the fundamental knowledge base of transitions into practical knowledge pieces which are useful in practical experiments; and (v) the ability to articulate the adequate knowledge questions in transition processes and translate them back to the research agenda.

5.5.3 Competence kits

Competence kits may include methods, analysis instruments, guidebooks, scenarios, simulation models and so forth.

These tools all contain knowledge in a form that allows actors outside scientific circles (consultants, policymakers) to use them to carry out analyses, choose interventions and so on without the need for additional scientific research. These kits are developed within the practice-oriented research (PO), and can be based on theoretical insights from FTP, or from practical experiences (Testing Grounds or Integrated Projects) .

Competence kits can be classified in two types:

*Competence kits in relation to knowledge about **transitions**:*

- Methodology for describing the system (actors, relationships, authority, external influences, driving powers and so forth).
- Methodology for describing a transition (type, phase, nature).
- Analysis method to map out interests, roles and objectives of diverse actors and stakeholders in the system.
- Scenarios for possible transition pathways.
- Models that describe and project a system's dynamic behaviour.
- Monitoring systems for tracing a transition's progress.

*Tools in relation to knowledge about **transition management**:*

- Methods for selecting the most appropriate strategy for a specific transition
- Methods for choosing the 'right' means (where, by which actor, at what time) to influence a transition in a specific situation.
- Methods to get multiple actors on the same page (formulating ideas, developing scenarios, formulating objectives, making decisions).
- Methods for arriving at mutual vision development, problem definitions and transition paths.
- Methods to communicate effectively with actors in the system.
- A conceptual framework for collecting methods and learning experiences during transitions.

5.5.4 Relationship Between Knowledge Development, Tools and Practice

Scientific knowledge and competence kits will continuously develop further during Knowledge Project implementation.

- A *body of fundamental knowledge* about transitions and transition management emerges from the FTP programme.
- PO research includes developing generic tools, adjusting them or making them domain-specific.

- Tools are consequently developed in a deductive manner for the practitioners who use and test these tools in TG IP projects. Empirically inspired competence kits will be given a theoretical basis using the FTP that can make an additional contribution to the *body of knowledge*.
- New fundamental knowledge questions for the FTP programme can emerge from the PT, PO and TG IP projects.
- The scientific process autonomously leads to new fundamental questions arising from the *body of knowledge*.

5.6 Preserving and Anchoring KSI

5.6.1 Situation at Knowledge Project Outset

At Knowledge Project outset there is:

- A Consortium of participants who subscribe to, carry out and help finance the programme (see section 2.2), of which the most important participants are: KSI, knowledge institutes, practice organizations, TNO, ECN and governments already involved.
- A programme for carrying out fundamental research in correlation with actual practice (section 4) and linked to competency development and exchange (section 4, section 8) as can be seen from the content and organization of FTP, PO, Testing Grounds and knowledge diffusion activities.
- A programme bureau taking care of the management of the research programme (section 7).
- Experiences and competencies acquired in practice with respect to initiating system innovations.
- Agreed upon working relations with Transforum and Transumo, and discussion on possible working relations with other practice organizations such as Habiforum, PSIB, and other intermediaries.

5.6.2 Situation After the Investment Impulse and Guaranteeing

After the financial impulse of Bsik has ended a dynamic situation has been achieved in which the following milestones have been realized.

A: Transition science has gained critical mass and is internationally recognized

Dutch research in the field of transition science has reached critical mass and gained international recognition to enable financing from the primary and secondary cash flow. The Dutch knowledge infrastructure comprises a number of multidisciplinary and interdisciplinary research groups whose contribution to developing and applying knowledge about system innovations and transitions can be established objectively. By executing the various projects within KSI these research groups have reinforced their mutual relationship and cooperation, and the research is embedded in affiliated research and education at the corresponding universities. New working relationships have been established with foreign research groups that are also active in this field, in particular embedded in European Networks of Excellence, such as the E-VIA network in the sixth EU-framework. Together this secures the continuity and consolidation of the knowledge generation in the national and international context.

B: Interface between fundamental transition science and practice programmes

The interface consists of a mechanism to anchor the fundamental knowledge base in practice programmes. This means a continuous and systematic translation of fundamental knowledge in a way that is useful for practitioners in practice programmes. The interface mechanism is equipped with some key people who are experienced in linking up theoretical concepts with practical needs, and vice versa. This guarantees the essential sustained exchange between fundamental research and the

practice of transitions.

C: Professional practitioners are available

Competent people, individually or in teams act as knowledge carriers and distributors. They apply their experience with transitions as professionals, as transition practitioners and/or as participants in one of our society's sectors or systems, or in the role of intermediary, consultant, instructor and the like. These people are active in governments, consulting firms, non-profit organizations and innovative businesses. Together, this guarantees the diffusion, application and the ongoing development of knowledge, as well as upholding a community of practice of individuals who are able to apply the knowledge successfully.

D: Applicable and validated tools are available

Part of the acquired knowledge and insights is recorded in the shape of available tools such as methods, scenarios, games, simulation and the like (see also §8.1 and §8.2). These knowledge products remain available in or through KSI. Resulting products, commercial or not, can be developed by commercial or non-profit parties, for example for consulting or training means. Based on the exchange between practical project and fundamental research, KSI works to keep tools up to date, test quality, identify missing tools and make tool use more professional. Together this guarantees the accessibility, quality and expansion of explicit knowledge.

E: Several transitions have been furthered

Pilots, programmes and implementation projects are underway in sectors of our society that can be viewed as steps in purposefully applied transitions. Similar (consecutive) activities generally have a long duration. KSI picks up where the Knowledge Project's implementing organization leaves off once the investment impulse ends with regard to the facilitating and direction functions it fulfils. This guarantees that the acquired knowledge and experience remain focused on society-generated demands and that investment in the knowledge infrastructure in the area of transitions will continue to produce a return after the investment impulse.

5.6.3 Evolutionary Transfer

The interactive nature of transitions and this Knowledge Project's approach makes it impossible to schedule precisely how the dynamic situation described in section 5.6.2 is achieved. However, we can establish that the transition from the initial situation to the post-investment impulse scenario will progress along the following lines:

- The FTP is the basis for an advanced and innovative scientific programme. According to their international position and results achieved, the participating knowledge institutes options for continuing the research after the Bsik-period and – within the framework of KSI - ascertain how much funding can be attained from the practice projects in the future.
- Practice organizations maintain working relationships through the Testing Grounds (Integrated Projects) and other types of practice-oriented projects within the framework of KSI and/or in cooperation with the knowledge institute network.
- During Knowledge Project implementation tools and methods can be developed by organizations such as consultancy firms and training institutes. This is one of the expressions of beginning knowledge diffusion as referred to in section 5.6.2 under point B.
- For structural embedding in higher education, an alliance is made in the first four years with the 'Sustainable Higher Education' initiative and the 'Learning for Sustainability' inter-administrative initiative, which concentrate primarily on social and technical competency development.

6 Approach, Method, and Implementation

The knowledge infrastructure that KSI wishes to develop must provide space and inspiration for the multidisciplinary, interdisciplinary, and transdisciplinary knowledge development necessary to enable transition management. This knowledge is expressed in such forms as analytic methods (for instance, to identify bottlenecks and opportunities for transition), instruments (for instance, to initiate and stimulate transition), models (for instance, to manage transitions and lay out transition arenas) and, last but not least, competencies to apply this knowledge in actual practice.

In KSI's view, a knowledge infrastructure of this kind is a precondition for realizing a sustainable society. Making a contribution to such a society is KSI's mission. For this reason, on a scale of real-life activities, KSI focuses on developing knowledge and the training of competent actors needed to initiate and assist in the processes that give rise to a sustainable society. Without fundamental knowledge about the progress such a transition makes, the repertoire⁷ for actors will be smaller and less accurate. Without validated tools to effect change the Knowledge Project cannot achieve its social aims.

6.1 Goals and Strategies

1. To develop a qualified network of knowledge institutes anchored in the Dutch and European knowledge infrastructure and specializing in system innovation, transition, and sustainability.
2. To generate fundamental multidisciplinary, interdisciplinary, and transdisciplinary knowledge and develop the instruments necessary to analyse, stimulate, initiate, and manage system innovations and transitions.
3. To develop competencies and a critical mass of competence carriers which serve to initiate, accelerate, guide, and influence system innovations and transitions.
4. To develop a dynamic mechanism to link fundamental scientific research systematically and effectively to experiences and questions that arise within practice projects inside and outside KSI.
5. To build a network of parties willing and able to play an active role in the transition to a sustainable society.
6. To demonstrate the effectiveness of this approach based on concrete, practical results.
7. To embed the Knowledge Project in an international environment.

To achieve these goals, the following strategies will be employed.

- *Goal 1:* To define, staff, and implement a scientific Fundamental Transition Programme with the help of knowledge institutes and researchers. This Programme will generate knowledge about system innovation, transition, and sustainability, which is, first, driven by gaps in fundamental research and, second, driven by practical demand from society.
- *Goals 2, 3, and 6:* To implement the Fundamental Transition in interaction with practice research and Testing Grounds (Integrated Projects) .
- *Goal 2:* To build up and evaluate a collection of instruments based on scientific knowledge, which are generically applicable.
- *Goals 3, 4, 6, and 7:* To define the required competencies, build up a sufficient number of competence carriers, have them carry out work in actual practice, and strengthen their

⁷ 'Repertoire' refers to the entire scale of methods and tools that actors can use in actual practice to influence transitions. These include fiscal measures, coordinating cooperation by way of an intermediary, removing obstacles to innovation, and creating space for experimentation. These methods can be individual or ongoing and can either serve to limit or to create space.

competencies and certify them. To implement other knowledge transfer activities.

- *Goals 3, 6, and 7:* To develop collaboration with Transforum and Transumo, and later on with other practice organizations and implement collaborative projects with which knowledge is exchanged and competence is built up.
- *Goal 7:* To develop an International Coordination function, building upon IHDP-IT's International Project Office.

6.2 Activity Plan and Time Schedule

In chapters 4, 7 and 8 all activities within this KSI Knowledge Project are described. This paragraph gives a general overview of the development of the Knowledge Project over time. The table below describes for FTP, PO, IP, International Coordination and for the Transfer of Knowledge, how operational activities are scheduled in 2004 - 2009.

The final document from the relevant Dutch Ministry ("beschikking") that indicated formally that KSI was allowed to start, was sent to KSI at the 22nd of December 2004. Therefore most sub-projects will start in 2005. Only a few activities started in 2004, expecting the formal ok. would come soon(er).

Activity	2004	2005	2006 & 2007	2008 & 2009	2010
Organization	Operationalization of KSI - Completion of staff & organization - Board and directors of KSI installed (dec) - Joint meetings with KSI projectleaders and with the whole network	- Programme management - International network building - Integration IPO IT - Evaluation - Activity plan 2005 - "Nulmeting" (mei)	- Programme management - International Network building - Evaluation - Activity plan 2006	- Programme management - International Network building - Evaluation - Activity plan 2007	- Programme management - Evaluation - Consolidation in infrastructure - Final reports
FTP - PO	- Preparation of cluster of projects	- Start of 3 research lines: first and second group of projects	- Continue 3 research lines - Continue second cluster of projects	- Continue 3 research lines - Consolidation in infrastructure	- Completion FTP - Consolidation in infrastructure - Establish funding
IP	- Formal cooperation with Transumo and Transforum established	- Start and Continue with Integrated Projects - Identification of new Integrated Projects	- Continue with Integrated Projects - Identification of new Integrated Projects	- Continue with Integrated Projects - Identification of new Integrated Projects	- Completion IP
Transfer of knowledge	- Formal Cooperation with CCT	- Start support programme 'Steunpunt Transitities' and CCT - Establish network with selected target groups	- Transfer to target groups, where relevant through CCT	- Transfer to target groups, where relevant through CCT	- Transfer to target groups, where relevant through CCT
Integration activities	- Meetings with all project leaders - Meetings with whole KSI network	- Meetings with all project leaders - Meetings with whole KSI network - Meetings per sub-programme - PhD Winter School - Conference	- Meetings with all project leaders - Meetings with whole KSI network - Meetings per sub-programme - PhD Winter School - Conference	- Meetings with all project leaders - Meetings with whole KSI network - Meetings per sub-programme - PhD Winter School - Conference - Joint publications	Meetings with all project leaders - Meetings with whole KSI network - Meetings per sub-programme - PhD Winter School - Conference - Joint publications
International Coordination	- Preparation for FP6 Programme Matisse	- Agreement and Integration IHDP IT network - Collaboration FP6	- Joint research proposals IHDP - EU transition conference	- Joint research Proposals IHDP - Collaboration FP6 Networks of Exc.	- Collaboration FP6 Networks of Exc. - Int. transition conference

		Networks of Exc.	- Joint Disseminat.	- Joint Disseminat	- Joint Disseminat
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The international coordination of the generation and dissemination of transition and system innovation knowledge has already been prepared in October 2003 at the Open Science Meeting of the International Human Dimensions Programme on Global Environmental Change (IHDP) in Montreal. It has been officially agreed that the International Project Office of one of the priority research topics, Industrial Transformation, will have a strong cooperation with the new KSI organization.

Consolidation in the existing knowledge infrastructure

As can be seen in the activity table, in the year 2007 and especially 2008 special attention is given to the structural consolidation of the knowledge and competences developed in this KSI Knowledge Project. In dialogue with potential hosting organizations (such as TNO) and government an agreement will be drafted that will safeguard a firm position in the knowledge infrastructure for KSI.

6.3 Milestones

Indicators for the progress and results of the Knowledge Project will be built up in cascade form. Indicators for the total organization will be based on an aggregate of indicators for FTP, PO, IP, and knowledge transfer supplemented by 'corporate' indicators. Each year, targets are determined and evaluated. All indicators are derived from the goals and the annual plans based on those goals. KSI will work on a more detailed monitoring system, including milestones for the new "nulmeting" due in May 2005. The information below gives a first indication of possible elements, but will be revised and completed.

The following breakdown is maintained for each of these subgroups and for the total:

- Indicators reflecting the substantive progress, quality, and quantity of results. These are specific to the various subgroups.

FTP:

- Publications in journals;
- success rate hiring assistants in training;
- the number of projects started compared with the target number;
- the number and quality of PhD theses;
- quality evaluation by IAB advisory committee.

PO:

- Number of 'trainees';
- quality evaluation by trainees;
- number of trainers trained.

- Indicators reflecting enabling factors. These can be defined in part at subgroup level and, often, at corporate level, associated mainly with positioning issues on the part of the organization and the success with which the organization functions; the number of different joint efforts between disciplines; the number of new IPs; input from actual practice in FTP, etc.; the number of international joint efforts, invitations to conferences, etc.; quantity evaluations by practice organizations.
- Indicators reflecting financial management success; expenditures and budget comparisons; scale of matching or other contributions from third-parties; private and other contributions; percentage of overhead.

7 Cooperation in the Consortium

7.1 Composition of the Consortium

A group of active and leading researchers in the field of transitions and system innovations have been engaged in a process of building the KSI network over the last two years. They have organised themselves in the Transition Sciences Knowledge Network (KSI).

The consortium members have demonstrated their ability to produce interdisciplinary research of high quality and relevance for understanding and managing transitions towards sustainable development. Many participants have already collaborated with each other on various levels. This longer history of partial collaboration does provide the consortium with a foundation for communication and cooperative research. The Bsik funding will lead to a sustained and deep cooperation.

The consortium consists currently of 11 universities and organizations for applied scientific research such as TNO. The consortium is open for additional partners. The organizations contribute the researchers, research facilities and infrastructure, the international contacts, and the resources and manpower for knowledge transfer.

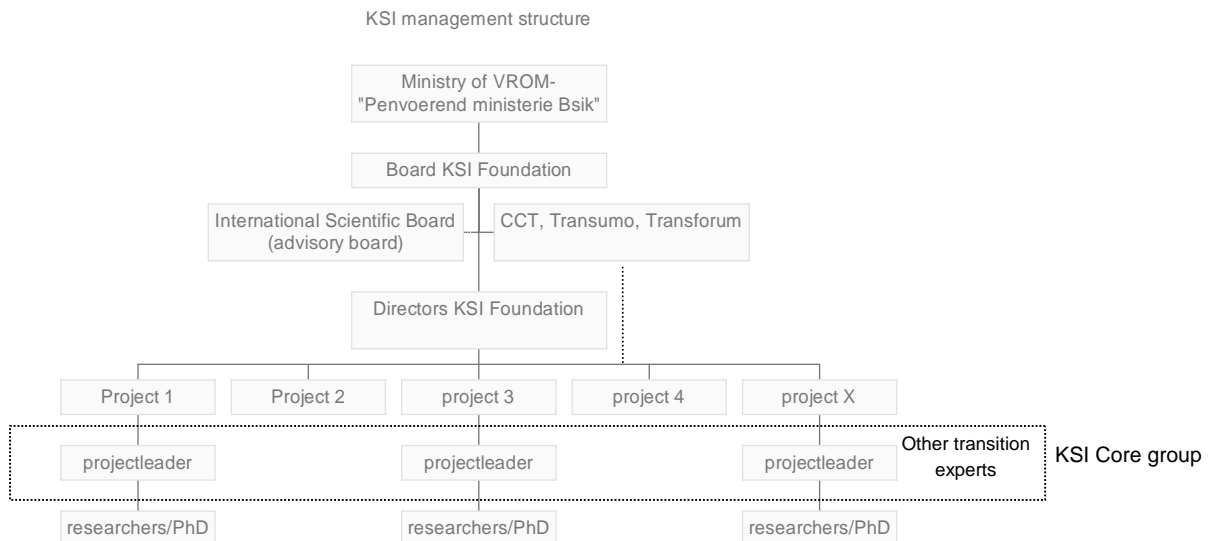
The KSI Knowledge project presented in this proposal can only be successfully by combining a broad set of knowledge and competences. The consortium provides such a combination by incorporating scholars from a variety of disciplines, including the hard sciences, social sciences and the arts. Their specialisations include: various engineering disciplines, sociology, political science, history, economics, social psychology, and a large number of more specialized subfields such as integrated assessment, technology assessment, innovation economics, innovation management studies, science and technology studies, history of technology, governance studies, future studies, and consumption studies. Moreover, many participants have been engaged with policy issues, and have experience in crossing disciplinary boundaries.

The KSI consortium includes now 10 universities and TNO. Four universities will form a centre of gravity for the consortium: University of Rotterdam (EUR), Eindhoven University of Technology (TU/e), University of Utrecht (UU) and University of Amsterdam (UvA). The universities and their leading scientists are described in Annex B.

7.2 Availability of Researchers and Practice Settings

The consortium participants understand the immense importance of implementing this Knowledge Project and guarantee that enough qualified researchers will be available to achieve the project objectives. The Cooperation agreement with Transumo and Transforum, and ongoing discussions with other practice organizations such as Habiforum ensure that Integrated Projects will be available.

7.3 Organisational Structure



7.3.1 Board

The KSI foundation has been established, which will be responsible towards the Ministry of VROM for the execution of the programme (as indicated in this business plan), the use and distribution of the funds over the partner institutes and the general strategy of the network. The Board of the KSI foundation consists of:

1. prof. dr. H. van der Laan (chair - independent)
2. dr. J.C.M. van Eijndhoven (vice-chair – EUR)
3. dr. W.R.F. Notten (treasurer – TNO)
4. prof. dr. D. V. van den Boom (vice treasurer – UvA)

7.3.2 Directors

The board has appointed four directors:

1. prof. dr. ir. J. Rotmans – chair & scientific director, with a special responsibility for sub-programme II on current and future transitions and for internationalisation activities
2. prof. dr. J. Grin – scientific director, with a special responsibility for sub-programme III on governance and for the interface between theory and practice, including relations with CCT
3. prof. dr. J. Schot – scientific director, with a special responsibility for sub-programme I, the historical programme for integration activities throughout the Programme.
4. mr. drs. M.E. Minnesma MBA – business director

The directors are responsible for:

1. the development of the programme;
2. general coordination and management
3. organisation of international coordination;

4. coordination of knowledge exchange and transfer, and development of competences/tools for the transition toolkit.
5. effective cooperation with Transumo and Transforum, as agreed upon in a joint declaration, and advise by the “Commissie van Wijzen”.
6. the organisation of the interface with practitioners in different sectors in transition, where relevant in cooperation with the Competence Centre for Transitions (CCT)

Jan Rotmans (chair and scientific director), John Grin and Johan Schot will act as co-directors, who are responsible for the management of the three proposed research programmes. They are internationally recognized leaders in their respective fields. They have excellent track records in successfully managing large-scale research projects.

The business director is responsible for organisational matters, financial management and design and the maintenance of all agreements among consortium members. In addition she will prepare all meetings, including those of the KSI board and support the board in organizing integration activities in between the research programmes. She will also manage general communication activities and liaise with the IHDP office, that takes care of some of the international communication activities. The directors are assisted by the secretariat and financial officers of the business director at the EUR.

7.3.3 The International Scientific Advisory Board

The International Scientific Advisory Board will be a platform for discussing and benchmarking the KSI research. This Board will advise on the scientific quality. They will have a two-day meeting each year in which the KSI projects will be presented. They will also participate in an annual KSI conference. The Board of NWO-MaGW has expressed support for the KSI Knowledge project, and agrees to nominate a member of the MaGW programme committee (probably GAMoN) as a representative in this International Advisory Board.

7.3.4 DSI Supervisory Board

The second high-level Board, is the DSI Supervisory Board, which is a joint Board of the three Bsik-programmes KSI, Transumo and Transforum. This board is chaired by an independent chair and further consists of the three Board chairs of the respective programmes.

The Supervisory Board will be a platform for bringing together the needs and issues raised in the daily practice of transition management and research questions and insights provided by KSI. These discussions will lead to learning among various organizations active in several domains (in particular transport, agriculture), identification and discussion of Testing Grounds (Integrated Projects) and needed practice-oriented research. This Board will have at least 2 meetings each year.

7.3.5 Project leaders and researchers

The scientific part of the KSI programme has been divided in three sub-programmes. Each sub-programme is led by one of the scientific directors and consists of a number of projects. The projects are led by senior scientists, with an outstanding track record in their field. The group of project leaders is an important backbone for the whole programme. At first they are important as leaders of their project, guiding the other scientists and especially the PhD students throughout the project. Secondly they have an important role as members of the core group (see next paragraph) and they are key persons for the dissemination of the results to other communities.

The group of all researchers and others involved in the programme will meet at the yearly conference. For the PdD students separate activities will be organised, like a summer/winter school and other meetings.

7.3.6 Core group

The directors, project leaders and a number of outside experts on transitions (in theory and practice) together form the so-called core group. These persons have committed themselves to an active role in the programme, especially in integrating the results and lessons learnt of individual projects into the knowledge base of the whole programme and in practice outside the programme. The activities of this group should ensure that the KSI programme is truly inter- and trans disciplinary. In order to make this possible the project leaders take part in many dedicated events, where they gather and exchange knowledge and ideas.

7.4 Special activities within the KSI Programme

7.4.1 Coherence and integration of activities

Achieving coherence is central for achieving our objectives. A range of measures are created to achieve coherence at several levels:

- On the project level: each project will have partners from other projects;
- On the programme level: the board is responsible for organizing coordination. They will have a sustained interaction. They also have a budget for funding integrating activities and small projects: They will organize summer schools, workshops, an annual conference, and invite researchers and practitioners to cooperate in writing essays and other joint products. See section 3.4.2.

7.4.2 Knowledge Exchange and Transfer

Knowledge transfer and communication (that is not target-group specific communication) are coordinated by the KSI office and the appointed interface manager. Contributing research results to the knowledge transfer pool is among the standard responsibilities of researchers. See section 8.

7.4.3 International Coordination

KSI will co-operate with the IHDP Industrial Transformation office, which will organize the international Scientific Advisory Board meetings, and also be responsible for organizing other international workshops and meetings on transition research, and provide a platform for international dissemination.

The international coordination function will ensure embedding of the Knowledge Project in the international arena. KSI will also actively engage in relevant EU-projects in the 6th Framework programme (FP6), like Matisse, which has a special part dedicated to research on transitions and system innovations. Through these projects, the results of KSI can also land easily and effectively within the European research community.

7.4.4 Cooperation with Other Knowledge Projects

The most important form of cooperation with other Knowledge Projects involves the implementation of IP and PO projects. Here, construction and exchange of knowledge and experience regarding transitions across sector boundaries is the shared objective. The cooperation with actors in Transumo and Transforum is of special importance. The directors will have regular meetings with their

counterparts in Transumo and Transforum for coordination purposes. Other important partners will be Habiforum, Leven met Water and projects within the Bsik programmes "8 voor ruimte".

8 Transfer of Knowledge and Competencies

8.1 Approach

In order to adequately cope with the complexity of the phenomena studied, research into system innovations and transitions requires a synthesis between fundamental theoretical and methodical work and empirical referents. It is therefore crucial that researchers have access to practice projects. On the other hand, it has become clear from projects in which such practices have been monitored, evaluated and guided with advice and training, that a truly deep social-scientific and historical insight in these projects is of great *practical use* in dealing with the complexities of system innovations. In the best case, the KSI Knowledge Project comprises an interface between knowledge development and practice which enables an efficient, mutually advantageous exchange between both realms. In the worst case, this interdependency leads to overburdening both researchers and practitioners, and/or contaminates both practice and research. In order to achieve the former and avoid the latter, we propose a limited but well functioning interface between research and practice. The structure should be flexible, to enable both adaptation to new experience and extension whenever the volume of practice and research projects would significantly increase.

The structure also takes into account the fact that system innovations and transition as empirically observable phenomena entail research, field tests, validation, and application; and the fact that the parties of this Consortium thus cooperate in 'real life' as well. 'Applications' of knowledge and competencies therefore do not exist in the conventional sense. Instead, FTP, PO, and IP form a single unit that is both a laboratory and a field of application where 'researchers' and 'final users' generate *and* apply knowledge together.

The practice-research interface basically has three two functions:

- It acts as a *broker* between researchers and practitioners, through a capacity to relate research interests to practice organizations;
- It offers *assistance to researchers* in articulating competences;
- It offers *assistance to practitioners in obtaining competences*.

In order to fulfil the *broker* function, experts at the interface are knowledgeable both about the research interests and expertise of researchers and research findings within the KSI Knowledge project as well as a thorough understanding of the nature and needs of practice-oriented programmes.

As a broker, interface experts

- Advise researchers what projects may be interesting as an empirical basis for their investigations, including suggestions on what existing data (in other research groups within KSI) or results may be available for secondary analysis. This increases efficiency of the network as a whole, stimulates exchange between different research groups and prevents that practitioners are overburdened by 'data mining' researchers;
- Help practitioners to articulate their knowledge needs, point them to already existing knowledge and help them to identify the research group(s) within KSI who may be most appropriate to meet their remaining needs.

The second and third functions concern competencies. Competencies may be made transferable in two different ways. First, findings of research may sublimate into concrete 'competence kits' such as tools (e.g. a software supported approach to regime analysis), learning histories (brief anecdotal episodes from practice projects which contain important insights), methodical guides for defining and managing system innovation projects or a system to disclose in a praxeologically relevant way the cases from the historical database. Second, there may be formats for competence transfer: modules

for on-the-job-training; proven modes of *Begleitforschung*, combining the monitoring of practice projects with evaluation and advice; or action research methods for further improving objects obtained by systematically applying them in 'pilot projects.'

In order to fulfil the second function, interface experts use their understanding of practice to help researchers to distil concrete 'competence kits' from their findings. Another task is to help them (or other groups) to develop these further in subsequent practice projects. The third function implies that interface experts help practitioners to articulate their needs for competences, to point them to available competence kits and bring them into contact with appropriate researchers, helping both parties to identify and elaborate suitable formats for competence development, benefiting from earlier applications of such formats.

8.2 Target groups and channels

Meanwhile, KSI has decided to co-found (with VROM, NOVEM, and TNO) the Competence Centre for Transitions as the location for its interface. The CCT has been founded for 3 years initially (1/1/2005 – 31/12/2007) but it is the partners' intention to create a need for continued existence throughout at least the entire Bsik period. Although some bare money may be invested, KSI's contribution will be mainly consist of PO projects and their deliverables. CCT staff, provided by TNO and NOVEM, will coordinate and facilitate processes for exchange between KSI researchers and practitioners; will play a major role in translating competences gained from research into kits that fit practitioners' needs and circumstances; will identify channels for competence transfer; and will help in articulating practitioners' emerging knowledge questions. In all these respects, CCT does not wish to compete with existing organizations with a similar or overlapping mission.⁸ It is KSI's intention to also bring IPs into the CCT infrastructure; as yet, while this idea has been received positively by Transumo and Transforum, a final decision on that issue still has to be taken. For a more extensive description of formal arrangements, we refer to the co-operation agreement in Appendix 4. Here, we limit ourselves to the more substantive issues.

Concerning PO research, the idea is that research projects yield elements that may be integrated with rudimentary competence kits (a '0.0 version'), developed in Integrated Projects, into the 1.0 version of competence kits. These elements may consist of both articulated competences and documented experiences with them. CCT staff plays a major role in this integration effort, which will be embedded in a process of interaction between practitioners and KSI researchers. The latter have committed them selves (also contractually) to:

- Provide the inputs just mentioned
- Engage in synthesising these, in interaction with practitioners and in co-operation with CCT staff, into competence kits that fit the needs and circumstances of practitioners

Concerning Integrated Projects, it has been arranged between Transforum, Transumo and KSI that KSI researchers will provide three types of contribution:

⁸ Three partners who may offer such channels are actively involved in the Knowledge Project: *Stichting Duurzaam Hoger Onderwijs* (Foundation for Sustainable Higher Education), the *Leren voor Duurzaamheid* (Learning for Sustainability) programme, and the 'Steunpunt Transitie' (Transition Support Service of the Ministry of Housing, Physical Planning and the Environment). Active transfer of the results from the KSI approach is most desirable for their implementation programmes.

- they will assist Transumo and Transfrom workers to acquire the required competences, among other things through developing rudimentary competence kits.
- (if a final decision is taken to have these IPs supported by CCT: together with CCT staff) they will contribute to monitoring and evaluating IPs, including the ways in which competence kits (do not) adequately contribute to these IPs
- they will critically reflect on the definition and, in later stages, the proceedings of IPs, as ‘ outsiders who are knowledgeable on transitions and system innovations, both empirically (earlier and in other domains) and conceptually. This is to contribute to enhancing the system innovative potential of these projects.

KSI researchers engaged in IPs:

- Get access to empirical data in the form of experiences gained
- Develop contacts with practitioners and their organizations
- Contribute time and expertise

In the Knowledge Project, all parties that figure prominently in the transition process are considered to be target groups; knowledge transfer is geared primarily toward individuals and groups already reasonably aware of the issues. Each target group requires a customized approach:

- actors in transition processes;
- managers at public and private organizations;
- state government staff responsible for transition management;
- scientific planners (NWO/STW);
- supervisors of national, regional, and local sustainability projects;
- students at higher vocational training institutes and universities;
- employees of the government, corporate industry, and NGOs involved in sector-specific transitions;
- opinion leaders and people remotely involved in transitions.

Most knowledge transfer focused on intermediaries is active. Passive knowledge transfer will be addressed as well by making project results accessible via a website. An overview of target groups, purpose, channels and process is given in the table below

8.3 Core Competencies

The table indicates how the active transfer of knowledge and competencies is achieved for each target group.

Target group	‘Steunpunt Transities’ and their target group: employees of state and local authorities responsible for transition management	Students at higher vocational training institutes and universities	Government authorities, corporate industry, and NGOs involved in sector-specific transitions
Purpose	Support target group with knowledge and competencies for the transition management assignment.	Integrate sustainability and transition knowledge and competencies in disciplinary and interdisciplinary final terms.	Parties acquire knowledge and competencies to fulfil their role in the transition desired.
Channel	‘Steunpunt Transities’	DHO Foundation	Transition departments and

			sector organizations (Innovatienetwerk, Leren voor Duurzaamheid, ECN/NOVEM, Habiforum, Connect) that figure prominently in the transition concerned.
Source of knowledge and competencies	PO, IP	PO, IP	Sector-specific IP, PO
Process	<ul style="list-style-type: none"> - Facilitate and advise curriculum. - Identify new knowledge and experience; translate to situation of transition practitioners concerned. - Organize reflection with relevant stakeholders. - Define the process with respect to the 'Steunpunt Transitities' assignment. 	The DHO Foundation trains teachers, who subsequently supervise multidisciplinary groups of 6 to 8 students in a transdisciplinary educational assignment. These teachers have attended a KSI course as preparation. This approach cultivates competence for all those concerned.	Devise a knowledge-transfer programme in conjunction with the sector organizations that integrate selected KSI-generated knowledge and competencies and sector-specific knowledge. Support for sector organizations in implementing this programme.

8.4 Indicators

The following indicators shall apply with respect to the progress and extent of the knowledge transfer:

- Defined knowledge and competence profiles (number under development, number elaborated);
- Learning arrangements, knowledge transfer programmes, and learning circles (number under development, number elaborated, intensity of their uptake);
- Number of coaches in training, coaches in the field;
- Number of curricula addressing transition management, number of students at higher vocational training institutes and universities encountering them, number of practical training positions and research projects;
- Ties with the 'Leren voor Duurzaamheid' knowledge management system and their use;
- Number of meetings, symposiums, and the like organized by KSI;
- Number of appearances at gatherings and symposiums organized by others;
- Number of publications (such as newsletters and information kits) and their circulation;
- Number of visitors and requests for information via the website.

Indicators are differentiated to reflect target groups and sectors as needed.

9 Abbreviations

BuZa	Ministerie van Buitenlandse Zaken (Ministry of Foreign Affairs)
CCT	Competentie Centrum Transitie (Competence Centre Transitions)
DHO	Duurzaam Hoger Onderwijs (Sustainable Higher Education)
EZ	Ministerie van Economische Zaken (Ministry of Economic Affairs)
FTP	Fundamenteel Transitieprogramma (Fundamental Transition Programme)
HBO	(instelling voor) Hoger Beroepsonderwijs (Institution for Higher Vocational Education)
IHDP-IT	International Human Dimensions Programme on Global environmental change/Industrial Transformation
Transforum	Stichting Transitie Duurzame Landbouw (Transition Sustainable Agriculture)
IPR	Intellectual Property Rights
KSI	Kennisnetwerk SysteemInnovaties: Transitie naar een duurzame samenleving (Knowledge Network on System Innovations: Transitions to a Sustainable Society)
LNV	Ministerie van Landbouw, Natuurbeheer & Visserij (Ministry of Agriculture, Nature Management & Fisheries)
LvD	(programma) Leren voor Duurzaamheid (Programme Learning for Sustainability)
NOVEM	Nederlandse Onderneming voor Energie en Milieu (Netherlands Agency for Energy and the Environment)
NWO	Stichting Nederlands Wetenschappelijk Onderzoek (Foundation Netherlands Scientific Research)
PO	Praktijkgeoriënteerd Onderzoek (Practice-oriented Research)
PP	Praktijkprogramma's (Practice Programmes, such as Habiforum)
PSIB	Proces- en Systeeminnovatie in de bouw (Process and System Innovation in the Construction Sector)
Steunpunt Transitie	Transition Support Service of the Ministry of Housing, Physical Planning and the Environment
STW	Stichting Technische Wetenschappen (Foundation Technical Sciences)
TG or IP	Testing Ground or Integrated Project
TNO	Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (Netherlands Organization for Applied Scientific Research)
V&W	Ministerie van Verkeer & Waterstaat (Ministry of Transport and Public Works)

VROM

Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieu (Ministry of Housing, Physical Planning and the Environment)

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