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Stockholm Resilience Centre Report



Action plan 2014-2018

Stockholm Resilience Centre

Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship



Stockholm University

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Stockholm Resilience Centre

Stockholm Resilience Centre advances research on the governance of social-ecological systems with a special emphasis on resilience - the ability to deal with change and continue to develop.

The Stockholm Resilience Centre was established on 1 January 2007.

The centre is a joint initiative between Stockholm University and the Beijer International Institute of Ecological Economics at The Royal Swedish Academy of Sciences. The centre is funded by the Foundation for Strategic Environmental Research, Mistra.

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1. Summary

This Action Plan is organized to outline our key achievements, activities we are committed to engaging in, and activities to which we aspire. We apply these categories to our research, academic capacity building, bridging science and policy, institutional development, and financing. The table below summarises the key points in this Action Plan. It is divided into sections based on the different areas of work of the Stockholm Resilience Centre (SRC). Throughout this document, however, we emphasize that the scientific research is fully integrated with the other parts of the Centre: academic capacity building; bridging science, policy and practice; leadership, management and institutional development; and fundraising/financing. Strategically these areas are mutually reinforcing and work to support each other in the overall ambition to continue developing SRC's role at the frontier of sustainability science and in bridging science, policy and practice.

The first column lists selected major achievements from the Progress Report 2007-2012, while the second include a number of plans and priorities based on our current commitments, given continued funding from Mistra at the level indicated in the original call. Finally, the third column describes a set of new opportunities or aspirations that can be realised if we manage to secure additional funding (see main text for clarification).

Areas of work	(A) Key achievements 2007-2013 (more detailed information in Progress Report)	(B) Commitment 2014-2018 (according to existing plans)	(C) Aspiration 2014-2018 (requires additional funding)
5. Research for biosphere stewardship and innovation	<ul style="list-style-type: none"> • Established a leading role in the frontier of inter- and transdisciplinary research for governance and management of social-ecological systems • Research restructured into three advancing insight themes and three cross-cutting themes. • Launch of – or participation in – key research projects and programmes like PECS, Beam, EkoKlim, URBIS, Nereus. 	<ul style="list-style-type: none"> • Continued evolution of themes with cross-theme initiatives (transformation, economics of global change, resilience and religion, SES typologies, cognitive resilience building) • Continue work with “research insight albums” • An increased focus on methods development, facilitated by the SRC modelling/visualization lab • Defining social-ecological typologies • Development of “Planetary boundaries research lab” and the Planetary Boundaries research network (PBnet) • Further strengthening of role as international science convener • Strengthen further the SRC's scientific relation to research departments and centres at Stockholm University 	<ul style="list-style-type: none"> • Developing a new “platform for global syntheses” • Develop further the global PECS programme on regional social-ecological research and develop a network of SRC-like centres in the world • Leadership role in Resilience Alliance and other sustainability science networks • Securing funding for a number of new long-term research positions • Establishing a Swedish node of the Sustainable Development Solutions Network (SDSN) of the UN SDG process, and the Future Earth initiative
6. Academic capacity building	<ul style="list-style-type: none"> • Established as trainer of next generation of inter- and transdisciplinary researchers and professionals on resilience and sustainability. • Organised two Master's programmes ('Ecosystems, Governance and Globalisation' and 'Sustainable Enterprising'), a PhD-level Resilience Research School and three independent courses. • Organised 18 different PhD-courses 	<ul style="list-style-type: none"> • Develop education as an attractor and integrator throughout the SRC's different areas of work • Own PhD programme through the merging with the Natural Resource Management (NRM) group from the Dept of Systems Ecology • MSc program development • Continued and deepened collaboration with RAYS and Beijer Young Scholars • Developing a set of new theme courses for PhD and MSc students 	<ul style="list-style-type: none"> • Boost of research school with a number of new PhD-positions • Establish a larger PhD/Post Doc level network in the full Stockholm region • Develop a PhD-program with a basis in social sciences, the humanities and law • Develop MSc cooperation with e.g. a few top universities globally • New MSc course in Economics in the context of Global Change

		<ul style="list-style-type: none"> • Test and develop internet-based MOOC courses on sustainability science 	
7. Bridging science, policy and practice	<ul style="list-style-type: none"> • Internationally recognised role in bridging scientific advancements in centre research to policy and practice • Convener of international science-policy dialogues • Effective communication of Centre research using and experimenting with innovative methods (web news, videos, social media etc) 	<ul style="list-style-type: none"> • Invest more actively in being our own convener. • Contributing further to the success of the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) • Contribute to the follow-up of the UN Rio+20 process of transforming the MDGs to Sustainable Development Goals (SDGs) (SDSN and SDG dialogues) • Strengthened dialogue with business, e.g. the new SRC international advisory board and partnership with WBCSD 	<ul style="list-style-type: none"> • Advancing a proposed platform for science based high-level dialogues on global sustainability, “the Stockholm Dialogues”. • Invest further in connecting science, arts and business (e.g. The Human Quest Initiative) • Increasingly invite to dialogues with key-stone actors in different sectors (e.g., the 10 most important actors in the world on fisheries)
8. Institutional development, leadership, management and working culture	<ul style="list-style-type: none"> • Significantly increasing the number of full-time research staff with tenure positions • Improved career pathways for staff • Established as international node for guest researchers, lectures, seminars, workshops • Developed flexible and effective leadership and management structure that supports learning and innovation • Effective administration well integrated in the Centre’s research, education and outreach 	<ul style="list-style-type: none"> • Finalise the development of SRC as a permanent institution • Work to further integrate the Centre at Stockholm University • Widen SRC’s institutional collaboration with other key universities nationally and internationally • Continued institutional evolution (leadership sharing (e.g. new Deputy Science Directors)/board/transparency/evolution of decision making) 	<ul style="list-style-type: none"> • New physical working environment in Albano (fully-fledged Centre for sustainability science) • Institutional support to the evolution of “SRC like” scientific nodes in the world (such as SARAS in Uruguay; PECS South Africa in Stellenbosch; Stanford and the new Santa Fe-styled systems research centre at NTU/Singapore)
9. Financing, fundraising, budget	<ul style="list-style-type: none"> • Developed appropriate budget planning and economic administration and personnel administration • Transparency of the budget and accounting structure 	<ul style="list-style-type: none"> • Further establishment of the new function to secure the long-term financing of the Centre, through newly employed fundraiser • Mobilising of grants through new cross-theme initiatives and new projects/programmes, e.g. PECS-related activities 	<ul style="list-style-type: none"> • Raise core funding level to 40 % of Centre budget • Ensure a replacement of Mistra core funding beyond 2018/2020 • Raise strategic investment in SRC of approximately 20 MSEK/yr in order to enable a step-change in SRC achievements (to full-fill the aspirational opportunity) • Identifying extended funding through the newly established International (Business) Advisory Board • Increased core investment from SU and external funding sources

2. Introduction

This Action Plan is written with the intention to activate the Mistra funding of the second regular phase (2014-2018) of Stockholm Resilience Centre. After Mistra's evaluation and thereafter decision to invest in a second regular phase, this Action Plan serves as a guiding document for SRC's operations 2014-2018, and it is included as an appendix to the agreement between Mistra and Stockholm University. It builds on the two previous plans for the start-up phase (2007-2009) and the first operational phase (2010-2013) and aims at clarifying the Centre's priorities at a strategic level in relation to the Centre vision and mission.

The main emphasis of this Action Plan is to highlight the ongoing development of SRC to further advance the frontier of sustainability science applying a social-ecological systems approach and resilience thinking in the light of the shared vision, mission and organisational identity. In this endeavour the scientific research is fully integrated with the other areas of work at the Centre: academic capacity building; bridging science, policy and practice; leadership, outreach, management and institutional development; and fundraising/financing. Strategically these areas are mutually reinforcing and work to support each other in the overall ambition to continue developing SRC's role at the frontier of sustainability science and in bridging science, policy and practice.

Throughout this document we first describe the plans and priorities for each area of activity (research, academic capacity building, etc.) based on our current commitment to further establish the SRC in the frontier of sustainability science and then develop a number of new opportunities or aspirations, to meet a growing demand for resilience based thinking on sustainable development, which can be realised if we manage to secure additional funding. The table above summarizes these two levels of ambitions while also listing a number of key achievements during the period 2007-2013.

A core strategy of the SRC is to continue to function and strengthen its role as an international, innovative research institution at the frontier of sustainability science, and develop means to avoid becoming trapped in an efficiency culture of predictable mainstream research. This means that while productivity within a given time frame is important, management for sustaining creativity and innovation in the Centre is required, where interdisciplinary teams coalescing around curiosity and problem driven science are supported, and that diversity and even ambiguity in concepts, approaches and methodologies are tolerated. Leadership in this context is less about control and more about "establishing and nurturing an appropriate culture", one which values creativity, builds trust and transparency, privileges unorthodox approaches and creative individuals, stimulates a sense of the possible, and provides the space and the resources to support individuals through periods of exploration. However, situations are also encountered when avenues that have not been productive or fruitful are closed down and resources remobilized (see also section 5.3 below).

The Centre looks upon itself as a creative hub for generating new scientific understanding; to draw on multiple perspectives and to build new scientific methods and languages, on the international arena. The SRC will continue to use its research framing to further the exploration and understanding of intertwined systems of people and nature, applying a social-ecological systems approach and resilience thinking- in a scientifically rigorous manner, which includes critical evaluation and testing of theory, with results subject to peer review and scientific testing and adjustments by the wider scientific community. We have no intention of becoming an advocate or uncritical proponent of resilience thinking.

There is rapidly growing academic interest in social-ecological systems research and resilience thinking as an integral frontier of sustainability science. There is also a growing recognition on the international policy arena and among key actors in society that resilience and sustainability are critical preconditions for human wellbeing and world prosperity. Furthermore, evidence is growing of rising social-ecological

turbulence in a world where the likelihood of abrupt changes, shocks and stress is on the increase, in an inter-connected world where social and environmental changes rapidly can propagate across scales and regions. However, the area of knowledge generation and scientific understanding of intertwined social - ecological systems is in an early, but steep, phase of development and needs to be considerably advanced. In this context novel inter-disciplinary sustainability science is direly needed within the academic system at large, offering science-based insights and training in dialogues with practice and policy on the new challenges of the Anthropocene and the need for reconnecting human activities to the biosphere and support of transformations to sustainability.

This Action plan is formulated with the overall strategic objective of enabling the SRC to continue a development at the international frontier of sustainability science, strengthening and building scientific networks and partnership across the world, and engaging in bridging science, policy and practice. To succeed, our conclusion is that the SRC will have to continue building and nurturing its interdisciplinary research environment, invest further in international research collaborations, and experiment with new ways of raising insights from our research among key agents of change. The key proposed areas of investment to allow for the SRC to take its next evolutionary step includes the following (see also Summary table above):

- Expand the SRC Resilience Research School and deepen the integration of its education and training within the overall core research process.
- Raise further our scientific capacity.
- Enable our long-term ability to define and initiate novel research, to synthesise new emerging insights, and to continue experimenting with inter-disciplinary research and training methods in a creative working environment
- Strengthen our role as a national and international science partner and convener.
- Develop SRC work on knowledge syntheses to become a more visible arena: a “SRC Synthesis Platform” on frontiers in sustainability science. It will, in addition to include scientific knowledge, include other knowledge systems, as policy and practice. This synthesis platform will be an arena for dialogues between academics and other constellations of the society.
- Continue advancing a proposed platform for science based high-level dialogues on global sustainability, “the Stockholm Dialogues”. The SRC Synthesis Platform and the Stockholm Dialogues will to a large extent be an integrated undertaking.
- Experiment with new ways of knowledge generation for change by integrating science, arts and business.
- Continue developing and experimenting towards becoming the best possible working environment for inter-disciplinary research and education.

3. Vision and mission

- The *vision* of the Stockholm Resilience Centre is a world where social-ecological systems are well understood, governed and managed, to enhance human well-being and the capacity to deal with complexity and change, to enable the sustainable co-evolution of human civilizations with the biosphere.
- The *mission* of Stockholm Resilience Centre is to *advance research for governance and management of social-ecological systems to secure ecosystem services for human wellbeing and resilience for long-term sustainability. We apply and further advance research within practice, policy, and in academic training.*

The vision of the Stockholm Resilience Centre sets the stage for the research focus of the SRC. The foundation for SRC research is to view humanity as an embedded part of the biosphere with social and economic development fundamentally dependent on its functioning. In the current era of the Anthropocene, humanity has become a major force in shaping the dynamics of the biosphere from local scales to the Earth system as a whole, in what we refer to as social-ecological systems. Social-ecological systems are interwoven complex systems of people and nature, nested across temporal and spatial scales in the globalised world. SRC research clarifies that in the interconnected globalised world, ecosystem services are not generated by ecosystems alone, but by social-ecological systems. Many social-ecological interactions are unexplored and unknown and need to be further investigated and understood.

The mandate for SRC is to contribute with knowledge generation, applying a social-ecological systems approach and resilience thinking, for improved understanding of the dynamics and interplay of social-ecological systems and ecosystem services in this new situation. The social-ecological systems approach, emphasizing humans as part of nature and the resilience lens have helped clarifying the dynamic challenges of living with change, thresholds and regime shifts, and the need to reconnect economic and societal development to the Biosphere. We are confronted with a new scientific endeavour – to generate knowledge and understanding of social-ecological dynamics supporting innovations and transformations that strengthen the capacity of the biosphere to sustain us, and translate this into operational governance and management to enable sustainable futures. Hence, research for biosphere stewardship and innovation has emerged as core focus of the SRC, and will be reflected in the SRC subtitle Based on the recommendations from the SRC 2013 evaluation, we have decided on the following subtitle *Stockholm Resilience Centre – sustainability science for biosphere stewardship*. Sustainable and innovative approaches to biosphere stewardship will be required for governance and management of social-ecological systems to secure ecosystem services for human wellbeing and resilience for long-term sustainability. Sustaining and developing our internationally leading role in *advancing research* will be accomplished through outstanding inter- and transdisciplinary research, collaboration with leading researchers and research environments worldwide, and fostering a new generation of researchers and academic leaders through inter-disciplinary academic teaching and training programs.

Establishing and nurturing our internationally recognized role in *bridging science to policy and practice* will be accomplished through interactions with strategically selected practitioners and policymakers in different parts of society from local to global levels, and by fostering an international arena, well anchored in the Swedish academic context, for science, practice and policy dialogues.

Communication is an integral part of the centre's work in bridging science to policy and practice, and dissemination of research. Target groups for communication and policy interactions go beyond high-level decision/policy makers, senior managers, and executives of private enterprises.

An efficient and supportive *administration*, an attractive and functional *venue* and an internal *working environment* that facilitates creativity are key prerequisites for making the operation of the Centre successful.

4. Overall direction and priorities

Building on our vision and mission, the progress so far, and the strategic goals defined in the previous action plan for 2010-2013 we below describe the commitments and aspirations for the coming phase for the years 2014-2018. These include the overarching goals and visions of where the Centre aims to be in 2018 on (1) research, (2) academic capacity building, (3) bridging science, policy and practice, (4) leadership, management and institutional development, and (5) financing and fundraising.

The starting points in defining this for 2014-2018 are that: (1) the first and foremost priority of the Centre is to advance internationally leading strategic research, (2) policy and practice interactions are based on advancements in science within the areas of priority at the Centre, and (3) the Centre is developing into an internationally recognized convener of science-policy dialogues and a leader in experimenting with new ways of bridging science with policy and practice to best foster exchange of experience and sustainable development.

The overarching strategic direction for the Centre over the coming five years is to maintain and strengthen our role among the world leading scientific institution on inter- and transdisciplinary research on the dynamics of social-ecological systems in relation to ecosystem services and global change, and the aim is to further raise our recognized position in bridging science, policy, and practice in support of sustainability.

A specific ambition in this context is to deepening on-going collaborations with a few selected international academic partners to form strategic partnerships, including extended exchange of research staff and students. Another specific ambition is to widening the SRC's basis in the Swedish academic system with extended partnerships to become, not only a Stockholm University centre, but also a national actor.

A fundamental feature of this Action Plan is to continue working as an organization that supports novel inquiries, flexibility, continuous innovation in our pursuit of new insights and knowledge generation. This is a continuous dynamic evolution of the Centre and requires a culture that values creativity, provides the space and the resources to support researchers and their collaborations through periods of exploration and nurtures diverse ways of knowledge generation.

Hence, a key challenge for SRC is not only to deliver on science, policy impact and on organizational indicators in an efficient manner. We are convinced that productivity and knowledge generation and the long-term success of such deliverables rests on the dynamic working culture set up to sustain creativity and innovation, support collaboration and collective action with an infrastructure (technical, financial, social) that enables researchers to perform at their best. During the coming years we will continue to develop our inter-disciplinary working culture and environment.

5. Science

5.1 A social-ecological approach

The research of the Stockholm Resilience Centre emphasizes that ecosystems in all parts on Earth are shaped by people and, at the same time that all people are fundamentally dependent on the collective work of the Earth's ecosystems – the biosphere and its generation of critical ecosystem services. Hence, and as stated in the Vision and Mission section above, the foundation for SRC research is to view humanity as an embedded part of the biosphere, fundamentally dependent on its functioning – a social-ecological approach that emphasizes humans-as-part of nature.

Humanity has become a major force in shaping the operation and dynamics of the biosphere, from local levels to the biosphere as a whole. Biosphere stewardship and governance challenges include a highly interconnected and faster world and new forms of cascading social–ecological interactions and in the context of planetary boundaries, as well as opportunities for social–ecological change innovation and emerging pathways of transformation towards sustainability.

SRC research is part of sustainability science, an emerging interdisciplinary field of inquiry. The core focus of SRC is to advance research at the frontier of sustainability science applying a social-ecological systems approach and resilience thinking. The SRC work on integrated social-ecological systems has roots in resilience thinking, ecological economics, systems ecology, common pool resources, and global change research.

In the next phase, we envision a stronger focus on work on social-ecological transformations, and research on emerging areas linking resilience thinking with behavioural science, theology and cognitive science. These emerging fields of inquiry arise from amongst others from SRC work suggesting that adapting to changing conditions along current development pathways may be less beneficial for human wellbeing than shifting pathways of development to novel trajectories, which in turn requires a better understanding of how deep changes in human values and behaviour occur, and explore how innovations and novel governance systems arise.

5.2 Our research framing and strategy

Since the beginning of the SRC, all research efforts have been framed by three core features, or boundary conditions, for SRC research;

- Society and nature represent truly *interdependent social-ecological systems*;
- Social-ecological systems are *complex adaptive systems*; and
- *Cross scale and dynamic interactions* represent new challenges for governance and management in relation to interdependent social-ecological systems and ecosystem services.

These three core features (or boundary conditions) guide the overall research direction, and will continue to serve as a significant attractor that allows for the emergence of diverse approaches from different disciplines within a common framing.

The foundation of SRC research and the content and direction of the framing is a central identity of the SRC that distinguishes SRC research from multidisciplinary collaborations in general. It provides direction for all SRC research in taking on our vision and mission, and serves as an attractor for international interest and engagement. Within this framework scientists define in a flexible way their curiosity and

problem driven research agendas, encompassing disciplinary, interdisciplinary and transdisciplinary collaborations.

The research strategy of the SRC is open, curiosity driven and welcomes any approach, method, perspective, epistemology or ontology from the social sciences, humanities and natural sciences that can contribute to a deeper understanding of the challenge for governance of social-ecological systems guided by the three features above and in the context of humanity as an embedded part of the biosphere, fundamentally dependent on its functioning.

The core features of our framing have been complemented during the start-up phase to highlight three major challenges in research for governance of social-ecological systems.

- The existence of potential tipping points (thresholds) and regime shifts and the challenges that implies,
- The adaptability of social-ecological systems to deal with such changes, uncertainty and surprise,
- The ability to steer away from undesired regimes and possibly even transform social-ecological systems into new improved trajectories that sustain and enhance ecosystem services and human wellbeing.

Human societies face a complex array of global environmental changes (including climate change) that interplay with interdependent and globalizing human societies. The mandate for SRC is to contribute with knowledge generation for improved understanding of the dynamics and interplay of social-ecological systems and ecosystem services in this new situation. It is in this context that the resilience lens becomes of interest. We emphasize three features of resilience for analysing social-ecological systems in relation to sustainability

- Persistence - in the face of change, buffer capacity, withstand shocks
- Adaptability - the capacity of people in a social-ecological system to manage resilience through e.g. collective action
- Transformability - the capacity of people in a social-ecological system to create a new system when ecological, political, social or economic conditions make the existing system untenable

The Centre works as a creative hub on the international research arena for generating scientific understanding; drawing on multiple perspectives and building scientific methods and languages. The SRC intends to continue using the research framework to further the exploration and understanding of social-ecological systems in a scientifically rigorous manner. With the research foundation and framework as an attractor, we perform curiosity-driven basic research improving understanding of interactions in social-ecological systems and their resilience in relation to ecosystem services and their stewardship.

The scientific work using a social-ecological systems approach and resilience thinking draws upon and integrates a variety of theories, methods, and approaches from across the sciences, rather than being constrained by one particular approach, theory or method. The curiosity problem-driven approach of SRC research ranges from inductive on-the-ground fieldwork exploring and learning about social-ecological interactions to conceptual development, synthesis, and hypothesis generation to statistical analysis and hypothesis testing. We strongly support quality control of research through the peer review publication system in science. A robust process of international peer review helps us develop and secure high quality research, serving as the foundation for education and outreach.

More specifically, the research methods used at the Stockholm Resilience Centre reflect the interdisciplinary focus of the Centre. Both qualitative and quantitative methods are used to address topics and scales from local to global levels. There is no exclusive or dominant methodology, which means that researchers choose methods depending on the problem addressed. Qualitative research methods used

include, e.g. semi-structured interviews, participatory observations, social network analysis, discourse analysis, content analysis, process tracing. Quantitative research methods used include, e.g. surveys, social network analysis, behavioural economic experiments, remote sensing, and multiple statistical approaches from multivariate statistics to time series analysis. These methodologies are used to gather environmental data, such as spatial and long-term environmental monitoring data, in order to understand distribution and change in ecosystem services or ecological processes. They are also used to collect social data, such as oral histories, local ecological knowledge, levels of compliance or policy participation, in order to understand the drivers and processes of social, economic and political change, and their ecological effects. Moreover, these methods are not only applied in small-N, within-case analysis and large-N, cross-case analysis, but also in intermediate-N analysis using methods such as Qualitative Comparative Analysis.

Currently three developments characterize methodology use at SRC. First, the involvement of stakeholders in workshops and focus groups, e.g. in behavioural experiments conducted with students and practitioners or scenario planning exercises, is frequently used as a way to obtain data and to ensure the societal relevance of the research. Outcomes of these methods are analyzed, for example, with qualitative and quantitative text analysis tools (e.g. Atlas.ti). Second, the research at SRC has started to concentrate on several central case studies, such as the Baltic Sea; the Sahel; South- and East Africa; the Southern Ocean; the Arctic and elsewhere. These are studied holistically using different disciplinary angles and with different methodologies. Third, as a result of these in-depth case studies, researchers are now experimenting with different types of mixed method designs, to create synergies between the quantitative and qualitative methodologies outlined above. Mixed method designs are useful where the research objective is to obtain general validity while maintaining empirical richness. Fourth, this methodological integration is often underpinned with reference to a widening range of theoretical backgrounds in relation to the resilience framework, including theories of environmental justice, the advocacy coalition framework, theories of path dependency and social change. In some cases the methodological integration has even led to the development of new theoretical concepts, such as 'social-ecological traps', 'fishing styles', 'water resilience' and 'planetary boundaries'. Fifth, and last, SRC has actively developed new models and methods for analyzing and understanding social-ecological interactions. Examples include social-ecological inventories, resilience assessments, novel statistical approaches to detect regime shifts, exploratory conceptual models and causal loop diagrams, complex mechanistic food web or precipitation models, threshold analysis (STARS) and generalized additive models, as well as bio-economic and game-theoretical models. These models are designed in such a way that they can incorporate the information from both quantitative and qualitative research, and several of these models are developed in collaboration with practitioners and used in scenario exercises.

Overall, we are positively surprised by the growing interest in social-ecological research and resilience thinking, both within knowledge generation and in science, practice and policy. Still, however, the scientific understanding of interdependent social-ecological systems, their stewardship in relation to ecosystem services and transformations is poorly developed and needs to be considerably advanced in order for the academic systems to offer robust insights in dialogues with practice and policy on the new challenges of the Anthropocene and the need for reconnecting human activities to the biosphere.

The approach to sustainability science developed by SRC is contributing to push scientific research frontiers through the combination of theory and methods from diverse disciplines, but also through the integration of policy, practice and education in this scientific exercise. The Centre does not separate science from outreach, or from education – these are all integrated in centre activities and this integration is a core mechanism for enabling high quality sustainability science and the impact this science has in policy, practice and education.

5.3 Moving SRC research forward and facilitating multidisciplinary cooperation

All research undertakings at SRC are done in temporary constellations or teams, which often self-organize for the question in focus. Almost all research is initiated by the researchers themselves (e.g. bottom-up) and based on a genuine and curiosity-driven search of new knowledge and understanding in relation to developing social-ecological dynamics. The Stockholm Resilience Centre often uses resilience as a lens to analyse these systems, framed by the strong focus on the three core boundary conditions and “challenge” questions as described above. This common focus is ensuring that research activities contributes to the Stockholm Resilience Centre angle on sustainability science and that science at the Centre is thereby focusing on biosphere stewardship and innovation for sustainable social-ecological systems, regardless of geographical scale or the resources addressed. The research themes have provided an important forum for interdisciplinary cooperation within this framework, e.g. through exchange of ideas between theory and practice, and between empirical insights from individual case studies and research frontiers.

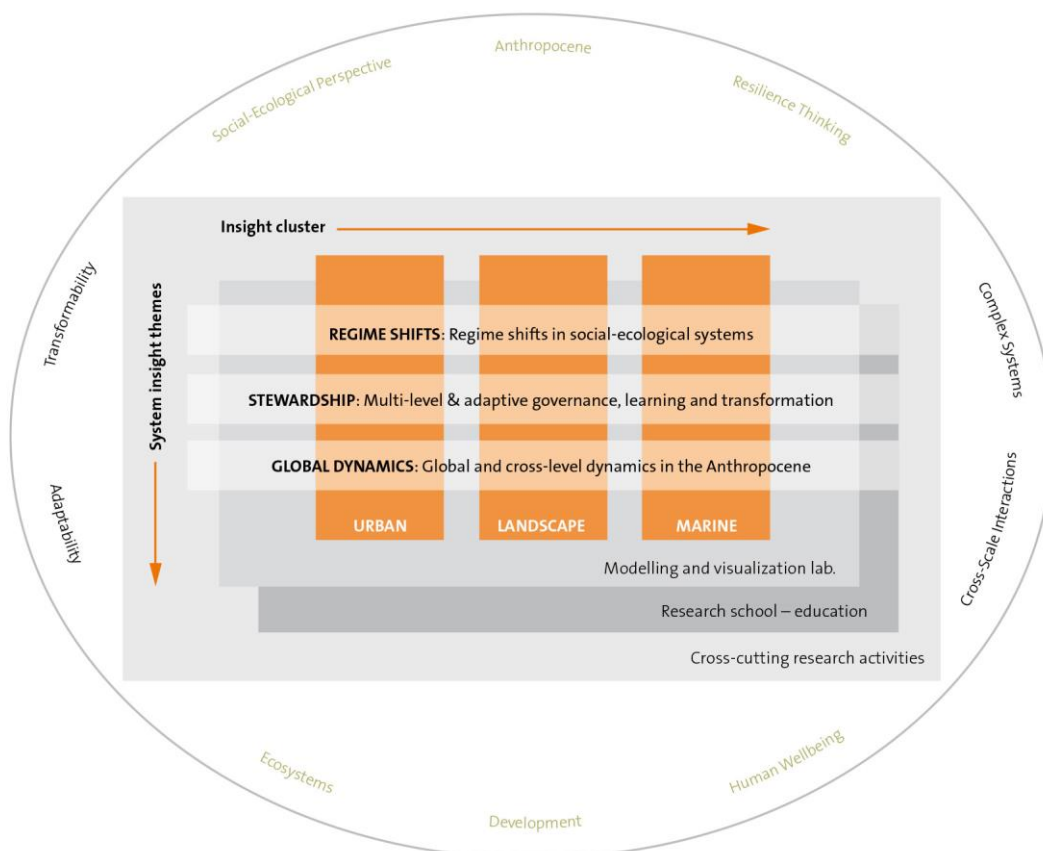


Figure 5.1: Current theme structure, activated 2010 and updated 2013.

5.3.1 Evolution of the theme structure and developing centre wide insights

The SRC research theme structure has been defined to ensure that we address the core features (social-ecological systems, complex adaptive systems and cross-scale interactions) major challenges (tipping points, dealing with change, transformations) and the three features of resilience, while at the same time covering important system types (water/food, urban, and marine social-ecological systems). The original eight themes consisted of four “Insight cluster themes” (Water/food, Urban, Marine, and Adaptive governance themes), which primarily focused on place-based issues related to freshwater/food, urban and marine systems. The original four “Thematic themes” (Regime shifts, The new economics of complex

SES, Knowledge management and Multilevel institutions) in turn, were more focused on developing and solidifying concepts and theories. These eight themes were later reduced to the current six themes.

The evolution of the theme structure is a consequence of strategic decisions as an adaptation to research findings and insights. The adaptive governance theme has provided an important source of inspiration for the insight cluster themes on Water, Urban and Marine systems, as it has enabled multidisciplinary cooperation between natural and social sciences. Several themes have directly benefitted from concepts, theories and methods developed within the adaptive governance theme. This evolution clearly illustrates how the adaptive governance theme operationally worked as a Cross cutting theme and by doing so, also led to the diffusion of this theme into all the other themes. The regime shift theme in turn, has been an important source of inspiration for other themes, linking theory and concepts with empirical case studies, and with the development of a regime shift database. A global theme was established in the second phase as a reflection of emerging insights from most of the existing themes, highlighting the importance of global dynamics and cross-scale interactions for regional and local outcomes.

Parallel development and insights in different themes has contributed to increased cross-theme interactions and centre wide insights (e.g., the “Insight Albums”, see Box 5.1). For the Action plan 2014-2018, we will stick to our strategy of combining Insight cluster themes with Cross-cutting themes, as this has been proven to be a successful model of operation. We perceive further developments of the Adaptive governance theme and analogous integration of the Global and Regime shift themes with the insight cluster themes and we envision a shift in balance from an emphasis of understanding social-ecological adaptation to social-ecological transformation as a generic focus of SRC research. We will also make a concerted effort to produce syntheses of findings and insights, through strategic interactions between themes.

BOX 5.1. Research Insight Albums

Research within the SRC research framework has generated a number of scientific insights. These include new propositions that call for a shift in perspectives and world-views to guide action in a fashion that reconnects people to the biosphere. Several of these findings have been synthesized in a format called “Research Insights”, which presents a selection of research findings, emergent results and propositions of research that have been generated from the centre since 2007. These insights help contribute to a broader understanding of social-ecological dynamics and resilience thinking. They are based on peer-reviewed publications of the centre, combined. The purpose of the research insight albums is to stimulate social-ecological research and resilience theory, within the centre and beyond.

Insights produced thus far includes Research insight albums #1: Transformations, #2: Regime shifts, #3: Adaptive governance, #4: Social-ecological innovations, #5: Social-ecological traps, and #6: Knowledge systems and learning, all available at the SRC website: A number of additional insights are currently being developed, including additional concepts, in depth case studies and theory development. The production of these insights has contributed to generating new and improved multidisciplinary collaboration within the centre.

5.4 Strategic development of syntheses and insights within and across themes

Continuous theme meeting and theme leader retreats, combined with spontaneous collaboration around specific problems or issues has generated substantial added value. The most recent years have generated increased such collaboration, both within and between themes, as the centre grows and the respective roles of individual researchers has become more clear. A number of theme leader retreats, Stora Karlsö kick-off trips, and generation of Research Insights (Box 5.1) have helped build important trust across themes and between individuals. Several areas for collaborative research, both within and between themes, are maturing into strategic scientific synthesis projects. Such areas include the development of novel ideas that simultaneously arise among researchers, e.g., the development of new theory, methods, frameworks and practice. Such initiatives serve as a platform for our strategic development and are ad-hoc and vary in scope, length, budget, and outputs. Despite the fluent nature of such initiatives, there are a number of clear directions that we will investigate during the coming period (2014-2018).

5.4.1 Within-theme evolution

The themes have proven to serve as important platforms for multidisciplinary cooperation, generating novel insights on coupled social-ecological systems dynamics from local to global levels, from the Arctic to the Antarctic, in temperate and tropic systems and in snap shot or long-term studies. Different approaches in themes allow for modularity and independent development of within-theme insights, in line with the vision and mission of the centre.

The **Urban theme (urban social-ecological systems)** views cities as integrated social-ecological systems focusing on their resilience in relation to change in the Anthropocene. The urban theme consists of two parts; a focus on global urban patterns and processes in relation to the biosphere, and a more place based focus on green areas and ecosystem services. The first part has built an extensive network of research groups in cities in Europe and around the world, leads a number of interdisciplinary project, and is also involved in several global collaborations contributing with e.g. development of methodology and analyses of urban ecosystem services. The second part addresses the capacity of urban ecosystems in cities to generate ecosystem services and the functional groups of species that provide them, in combination with governance networks, social dynamics and the built environment. Research insights are translated into principles, landscape designs and applications in the science-policy-practice interface, promoting sustainable urban development. There is substantial joint collaboration with the Beijer Institute in the urban theme.

The **Landscapes theme or (freshwater, food and ecosystem services in dynamic social-ecological landscapes)** has primarily focused on issues related to semi-arid and arid regions, which are often “trapped” in undesirable states. The theme has investigated reinforcing social-ecological feedbacks, the production and governance of bundles of ecosystem services, green and blue water flows and rainwater harvesting. The theme will increasingly focus on the role of power and social networks at multiple geographic levels, investigate technological and social innovation, trade-offs and potential synergies between different goals or ecosystem services, identifying thresholds and regime shifts, and identify strategies for building general and specific resilience in drylands. The theme strives to integrate these findings in cross-cases study comparisons, development of typologies, and modelling approaches that can contribute to a growing demand for this research from policy and practice. Collaboration with Stockholm Environment Institute (SEI) is strong in this theme.

The **Marine theme (coastal and marine social-ecological systems)** has focused on developing an in depth understanding of social-ecological dynamics in a range of case studies around the world and at different geographical scales. Recent developments within the theme include the use of qualitative and quantitative cross-case study comparisons designed to draw out general understanding of coupled social-ecological dynamics in marine systems, an increased focus on cross-scale dynamics and the specific role of trade in that context, land-sea interconnections in the food production system and the development of social-ecological models. Collaboration within the theme has significantly been strengthened through strategic funding in a number of research programmes (Normer, BEAM, Nereus) and the theme has also significantly increased the number of international partners during recent years (e.g. NOAA, Princeton, University of British Columbia, SARAS), enabling access to valuable data sets for analysis of social-ecological dynamics. There is close collaboration with the Beijer Institute in the marine theme.

The **Regime shift theme (regime and their implications in social-ecological systems)** has developed a framework for comparing regime shifts in the Regime Shift Database and is focusing on comparing dynamics of these regime shifts and to develop new theory and practical tools for understanding social-ecological regime shifts. The database currently include dryland, marine and global regime shifts and is an important resource in our education (MSc and PhD level) program. Students are continuously involved in updating, developing and analyzing information in the database, where they are adequately credited. During the next strategic phase, the theme will work to identify key drivers of regime shifts, linking bundles of ecosystem services to regime shifts, investigating feedbacks and traps in regimes, integrating

our understanding of regime shifts with Ostrom's institutional framework, investigating regime shifts in the context of transformations and also to study how cross scale dynamics shape regimes.

Research in the ***Stewardship theme (multilevel adaptive governance, learning and transformations)*** is largely explorative and has emerged almost inductively by observing patterns in case studies across organizational levels and across the world. Research in the theme has focused e.g., leadership, collective learning, networks and bridging organizations, agency, social-ecological innovations and transformations, conflict versus cooperation, accountability, and the problem of fit between societies and ecosystems. The next strategic phase of the centre will focus on linking these issues more closely to on-going and emerging research across all themes, including an increased empirical analysis of these concepts with additional empirical data. There is substantial collaboration with SEI in this theme.

The ***Global Dynamics theme (global and cross-level dynamics in the Anthropocene)***, jointly developed with the Beijer Institute, has investigated stewardship challenges associated with combinations of local and regional drivers (biophysical, social, economic) of social-ecological systems and intertwined global-scale challenges, including climate disorder, ocean acidification, declining fisheries, urbanisation, emerging diseases, antibiotic resistance or crises in energy, food, and water. The work with the planetary boundaries is a central focus of the theme. The theme has addressed unexpected links and feedbacks, which are likely to result in nonlinear and possibly even irreversible shifts in the behaviour of the biosphere. Understanding the dynamics of global boundaries, global interconnections and feedbacks, and investigating potential futures and opportunities within the planetary boundaries, will constitute the core of the research strategy for the theme. The ambition is to advance these issues through an increased use of models, global case studies (e.g., through the PECS programme) and relevant data.

5.4.2 Strategic cross-theme initiatives

The operating mode and structure of the SRC, informal interactions and formalized theme leader retreat has generated the identification of a number of proposed cross-theme initiatives. The issues addressed in these initiatives revolve around research questions that have emerged somewhat independently within several themes, but where it is perceived that increased cross-theme interaction will facilitate the moving forward of critical research frontiers in sustainability science. For instance, several case studies have triggered a rapidly growing research field that addresses sustainability transitions – i.e. how can institutions move from, towards, sustainability? This question has generated numerous partial insights from a range of different case studies and the ambition during 2014-2018 is to significantly advance the understanding of *“Transformations and Social-Ecological Innovation”* (Table 5.1).

The concept of ecosystem services, a cornerstone in the Millennium Ecosystem Assessment, is rapidly becoming an integrated part of policy and practice. However, several applications of this concept include a clear valuation or conservation agenda, and they are therefore not particularly suited for research on social-ecological systems from a resilience perspective. Researchers within the Centre have engaged in developing a cross-theme initiative clarifying what a *“Social-ecological resilience perspective on ecosystem services”* entails, in order to clarify challenges and potentials in using ecosystem services in policy and practice.

An additional emerging cross-theme initiative under development is related to *“The role of cognitive resilience in reconnecting to the biosphere”*, stemming from an increased interest to investigate narratives, cognitive frames, myths, mental models and world views when determining outcomes in social-ecological systems. This cross-theme initiative aims to investigate how different aspects of cognition act as barriers or enabling conditions for biosphere stewardship. Within this field of emerging research we are furthermore interested in exploring the crosscutting scientific area between resilience and religion.

Closely connected to the cognition cross-theme initiative is a forth, emerging cross-theme research area on *“behaviour, economics and nature networks”*, in close collaboration with the Beijer Institute. The programme will focus on human behaviour in relation to complex social-ecological systems and the sustainability challenges of the Anthropocene. The purpose is to investigate and contribute to an empirically grounded theory of human behaviour addressing individual as well as aggregate human behaviour in relation to ecosystem services, resilience and social-ecological change. Insights and theory from behavioural economics, game theory, network analysis and agent-based modelling will be combined with understanding of social-ecological dynamics generated in SRC themes.

A fifth cross-theme initiative aims to investigate similarities and differences in how *“global dynamics influence social-ecological dynamics at different temporal and spatial scales”*, including novel interconnections and feedbacks shaping the generation of ecosystem services in landscapes and seascapes. A globally interconnected world plays out continuously in local and regional contexts, as drivers of change and as shock events and surprises. Investigating how such dynamics, coupled to e.g. financial markets, supplies chains, emerging technologies, demographic change, geo-political shifts can influence potential global futures and opportunities is another area of cross-theme collaborations.

There are many linkages to the cross-cutting themes (urban, marine and landscape) here, on how to feed the world in the face of urbanization, while retaining local resilient flows of ecosystem services and local food sovereignty or how to stimulate transitions towards urban governance institutions in better collaboration with the functions of the biosphere. This area will benefit from the close collaboration with the Beijer Institute and also the new Academy initiative; the Persson Programme on the ecological economics of global change. This joint work will strengthen the capacity for analyzing economic dimensions of global environmental change, like emerging markets, key actors in economic transactions, incentives and institutions, and build a new generation of scholars with the ability to analyze the role of the global economy in the Anthropocene. This cross-theme initiative has the potential to stimulate the development of a deeper understanding and appreciation of the economy as a subset of the biosphere and the challenges and opportunities that it entails, with implications for economic development pathways and social-ecological transformations.

Table 5.1: Strategic cross-theme research synthesis

Name	Strategic focus	Key issues to address
Transformations and Social-Ecological Innovation	Develop theory and methods to better understand the dynamics of <i>social-ecological</i> transformations	<ul style="list-style-type: none"> • Social-ecological-technological interactions and innovation • Agency and transformation • Transformation patterns
A social-ecological resilience perspective on ecosystem services (ES)	Develop the ES concept to better address ES in the context of social-ecological systems, human well-being, cultural services and non-linear dynamics	<ul style="list-style-type: none"> • Bundles of ES and human well-being • Commodification of ES and human well-being • Social-ecological systems and ecosystem services
The role of cognitive resilience in reconnecting to the biosphere	Understanding how differences in cognitive frames influence dynamics of social-ecological systems and potential for transformations towards ecosystem stewardship	<ul style="list-style-type: none"> • Clarifying underlying mental models of human-nature relationship • Identifying triggers that can change cognitive frames toward reconnecting humans and nature
The role of global dynamics and cross-scale interactions	Understanding how a small number of highly connected international players can shape social-ecological dynamics at multiple scales and investigating the interactions between financial, ecological, political economy	<ul style="list-style-type: none"> • Clarifying channels of global resource flows and their impacts on social-ecological outcomes • Investigating factors contributing to the resilience of global actors
Behaviour, Economics and Nature Networks	Understanding human behavior in relation to complex social-ecological systems and the sustainability challenges of the Anthropocene	<ul style="list-style-type: none"> • Investigating human behavior at individual and aggregate levels in relation to ecosystem services and resilience. Combining behavioral economics, game theory, network analysis and agent-based modeling with understanding of social-ecological dynamics generated in SRC themes

Such cross-theme initiatives will consolidate the existing knowledge base from SRC researchers, develop methods, syntheses and joint funding applications and foster a broader dialogue on key research issues. The ambition with all cross-themes initiatives is to publish synthesis papers in high impact scientific journals.

5.4.3 Strategic methods development

The research frontiers that will be investigated during 2014-2018 require the increased use of existing methods in combination with new methods. The SRC Modelling and Visualization lab will serve as an important platform for facilitating the use of qualitative and quantitative methods and simulations as described below. An increased focus on methods development during the next strategic phase is a consequence of a general perception within the centre that more in depth and robust insights can be developed by combining different methods (e.g. field studies, experiments, modelling) to address specific research questions. Case studies provide rich elaboration of place specific multilevel processes and cross-scale social-ecological dynamics, but insights from practical case studies are further developed through collaboration with theoretical approaches, additional case studies and modelling. The large variation in the combination of approaches used by centre researchers has created a “collective intelligence” related to relevant approaches used and their combination will be effectively developed during 2014-2018.

Table 5.2: Strategic methods development

Method	Strategic focus	Tools
Cross-case study comparison methodology	Investigating variables and outcomes from multiple case studies in order to draw out generic insights of SES systems dynamics	<ul style="list-style-type: none"> • Qualitative Comparative Analysis (QCA)
Combining structure and process perspectives	Combining micro- level structure and macro-level function to better understand cross-scale interactions and the emergent dynamics of SES	<ul style="list-style-type: none"> • Combining structural and functional frameworks for SES analysis (e.g. Ostrom's SES framework and Resilience Thinking, structural and functional typologies) • Linking agent-based with system dynamics approaches
Defining social-ecological typologies	Develop social-ecological typologies to identify patterns between types and outcomes and leverage points for enhancing resilience or enabling transformations	<ul style="list-style-type: none"> • Developing Social-ecological network analysis • Simulation modelling
Developing models to simulate co-evolutionary processes	Develop stylized models of actor-environment interactions to study causes and consequences of non-linear change and capacity of a social-ecological system to adapt and transform.	<ul style="list-style-type: none"> • Agent-based and system dynamics modelling • Integrated assessment models
Experiences from transdisciplinary research	Synthesizing experiences from case studies and collaborations with diverse actors	Combining diverse knowledge systems for understanding complex SESs

Cross case comparison methodologies includes both hypothesis testing drawing on statistical inference, but can also involve explorative approaches like identification of common patterns across cases leading to the generation of tentative insights and new hypotheses on general systems functioning. A fundamental requirement for enabling these insights is the development of robust methods (e.g., Qualitative Comparative Analysis - QCA), tools and frameworks (e.g., the Ostrom social-ecological systems framework), combined with their further development to capture the dynamics of social-ecological systems. Developing such methods, tools and frameworks will enable support for data analysis and ensure consistent (yet flexible) data treatment.

Combining structure and process oriented perspectives in studying social-ecological systems, is another area where methodological development is critical in order to develop a more comprehensive understanding of cross-scale interactions. A process-based or system level view focuses on aggregate processes and flows between different stocks (e.g. stocks of fish or water, social welfare) with the aim to understand system behaviour as it arises from interacting feedbacks between different stocks or processes. The benefits from the system dynamics or process-oriented view lie in the potential to investigate feedbacks and their impact on the response of a system to change at the overall system level. System dynamics approaches however, often neglect heterogeneity and dynamics that happen at a lower, e.g. individual, level and the effect they can have on the macro-level and do not account for the fact that the nature of systems may change over time. Structure (e.g., network analyses) or interaction-based approaches (e.g. evolutionary game theory or agent-based modelling) focus on the generation of macro-level properties through interaction of micro-level entities over time. Combining structure and process oriented perspectives allows for more in-depth understanding of cross-scale interactions, e.g. the influence of macro-level phenomena on micro-level interactions and vice versa, and the interaction of structure and function in shaping system change.

The aims of *defining social-ecological typologies* are to a) generate a more systematic and general understanding of SES, b) serve as a tool for SES analysis (including models, see below), c) enable prediction of likely SES outcomes associated (through scenarios, see below) with different types of SES and d) advance theory about SES change. A typology or classification of SES can be developed according to many different dimensions, such as temporal and spatial scales, connectedness/modularity, etc. Each

typology serves specific purposes/ research questions and can focus on different aspects such as different types of regimes or different constellations of linkages or feedbacks. Based on an understanding of common types of SES and patterns between types and outcomes, a typology can help to identify likely trajectories, thresholds and leverage points for enhancing resilience or enabling transformations. Typologies can also support case study comparisons.

Case study comparisons, combining structure and process oriented perspectives and generic system typologies will contribute to and benefit from the *Development of models to simulate co-evolutionary processes* in social-ecological systems with the aim to generating generic insights related to SES dynamics. Such simulation models are currently developed within e.g., the “Planetary boundaries research lab” (global social-ecological systems dynamics), within the Nereus programme (Global marine ecosystem dynamics) and within our research cluster on the Baltic Sea (Regional social-ecological systems dynamics) and the SES-LINK project (regional and local social-ecological systems dynamics). Simulation models provide insights into possible future systems evolution through interactions of social and ecological variables. They can serve as a tool to test the relevance of specific interactions for explaining system level outcomes, e.g. by turning selected processes on and off or comparing different system structures to understand their impact on outcomes.

Recent strategic recruitments, infrastructure investments (Planetary boundaries research lab), grants (Nereus, BEAM, Regime shifts, NorMER, SES-LINK) and themes (Global dynamics) have substantially increased the SRC capacity to conduct such simulation modeling. The Modelling and Visualization lab will take on a facilitating role across different research groups and themes and maintain suitable technical infrastructure.

5.4.4 Comments on Mistra’s 2013 evaluation report

Finally, and as a reflection on the suggestions from Mistra Evaluation Panel 2013 regarding SRC’s research priorities, we want to stress that SRC has proven to be successful in providing new integrated “big pictures”; i.e. analyses, frameworks or concepts that give a partly new perspectives on broad sustainability issues. We have a strategic choice of staying and dig deeper into these revealed concepts or to move on and explore new concepts. The suggestions from the Panel indicate that we shall dig deeper and broaden the already existing concepts. We agree that we shall do that, but not at the expense of also exploring the still unknown ones. We will, for example, dig deeper and further develop research, including the social-science dimensions, of our planetary boundaries research, especially within our research theme *Global and cross-level dynamics in the Anthropocene* and in the *Planetary research boundary lab (PBRL)*.

Moreover, SRC is consciously building research capacity internally on the social dimensions of sustainability science, not least linked to development issues and adaptive governance. With our far-reaching interdisciplinary (sustainability science) approach, this may not be that easily recognized by traditionally trained social scientists. This dilemma is mirrored also within the natural sciences. Again, a strategic question is also what the core team of SRC researcher shall focus on and what strategic partnerships we should strive for? We try not to focus our limited resources heavily on topics where there already exists well-established expertise that is keen to cooperate with the SRC. On the issues of human well-being, equity and justice, democracy and power, which the Panel highlighted as important areas, we have recently improved capacity through e.g. the UK funded Ecosystem Services and Poverty Alleviation (ESPA) Framework Project. We also want to refer to a strategic partnership which is under elaboration with the STEPS Centre in the UK who has world leading expertise on these issues.

5.5 Theory development on resilience and social-ecological systems

Resilience thinking emphasizes the understanding of interplay between periods of gradual change and periods of abrupt change and their interactions across scales. These features are still largely unexplored and there is scope for new theory development here. Furthermore, the SRC research agenda emphasizes an integrated social-ecological systems approach, which implies moving away from analyses of the social and the ecological as two systems that are coupled to an intertwined system of people and nature. This shift implies theoretical challenges with the scope for new theory development, for example through the work on social-ecological typologies. Also, a rich and growing literature addresses specified resilience, the resilience of a particular aspect of a social-ecological system to a particular kind of disturbance. Less focus has been placed on general resilience. General resilience is the capacity to absorb shocks of all kinds, including novel and unforeseen ones.

The challenge of building resilience to unknown disturbances is far more difficult than planning for known types of disturbance, and like any management strategy it has a cost. Many short-term successes of adapting for specified resilience have proven failures in the longer term, creating difficult social-ecological traps to move away from due to lack of general resilience. Many practical pleas for adaptation lack a theoretical foundation and we envision that strategies for general resilience building will become of significance for stewardship and governance in the Anthropocene. There is scope for major theoretical advancements here on the tension between specified and general resilience, and combining such a focus with emerging theories in resilience thinking of how fast and slow variables interact in relation to adaptability and transformability and across scales. The regime-shift database will be a rich source for such theory development.

Theory on social-ecological systems and their dynamics in relation to resilience will also be generated through the now increasingly rich set of ongoing empirically based case-studies of the SRC as well as empirical work on global dynamics and planetary boundaries. In this context, the scientific framework and the comparative studies of the Programme on Ecosystem Change and Society (PECS), for which the SRC serves as international program office, will be of great help.

5.6 Resilience and the SDGs

Resilience thinking has inspired the global dialogue on sustainable development, most recently through the UN Secretary General Ban Ki-moon's Global Sustainability Panel report to the UN Rio+20 Earth Summit in Rio de Janeiro, June 2012 ("Resilient People, Resilient Planet"). This report was supported by scientific syntheses coming for the 3rd Nobel Laureate Symposium on Global Sustainability (Ambio Special Issue; hosted by the SRC, KVA, SEI and PIK), and the "State of the Planet Declaration" emerging from the "Planet under Pressure" science conference 1st half of 2012. These scientific advancements point in a new direction for sustainable development, namely that in the Anthropocene, where regime shifts at larger scales cannot be excluded, sustainable development can no longer be pursued at the community, sector, nation or regional level alone. Now, global sustainability and the resilience of social and ecological systems, must form an integral part of human development, at all scales and over long time periods. There is a growing need for social-ecological resilience thinking; from social and ecological systems to the emerging field of "Earth system resilience"; in support of sustainable development thinking. One key policy strand in this regard, is the UN decision (at Rio+20) to transform the Millennium Development Goals (MDGs) into Sustainable Development Goals (SDGs). This opens the opportunity to advancing a unified framework that integrated human development with resilience and global sustainability (basically a paradigm of human development within the safe operating space of the life-support systems on Earth). The SRC is actively engaged in this research area, through Future Earth, the Sustainable Development Solutions Network (SDSN), and the newly established Earth League.

5.7 Strategy for developing capacity to act as international science convener

A lot of the research at the Centre takes place across themes and not least in collaborations with individuals and groups outside the Centre, nationally and internationally. SRC has already from the start had the dual strategy of building critical mass of research staff under one roof in Stockholm and to advance its international network of leading researchers and institutions. An in-house research capacity that regularly interacts with a first class global network is one of the most important factors behind reaching and staying in a world leading position. In fact, this is a self-reinforcing spiral; a stronger Stockholm node leads to attractiveness in the global network, and *vice versa*. It builds convening power. During 2014-2018, we will increasingly act as convener with an ambition to increase the scientific production through series of international workshops and invited international experts identified to contribute with unique competence that complements existing capacity within the centre.

5.8 Strategy for publication

The core strategy is to produce scientific publications of the highest quality in relation to our vision, mission and research framework. So far SRC researchers have, as first- or co-authors, produced more than 525 publications in scientific journals and books. There are more than 350 scientific papers in more than 150 different both social and natural science oriented journals and 25% of these publication are in journals with an impact index over 4 (see SRC's Progress Report 2007-2012). In our view, it is not a goal in itself to reach out into intra-disciplinary top journals, whether in the natural, social sciences or the humanities, but rather to publish in journals that provide the most spin-off effects in dissemination of the results, irrespective of discipline or field. This is a significant strategy, particularly in the light of the inter- and transdisciplinary nature of SRC research, which generally has multi-authored publications across several disciplines. Also the interest and acceptance of disciplinary journals to findings on social-ecological systems varies significantly between areas and disciplines. We certainly encourage our researchers to submit to conventional and high ranked more narrow disciplinary journals but do not believe that success of influencing scientific discourses should be related to the number of such publications. The culture of disseminating scientific results, knowledge and understanding to the broad international research community is strong in the SRC and publication in respected journals is, and will continue to be, a significant part of the operation of the SRC.

5.9 Transforming Sustainability Science – significantly stepping up planned efforts at SRC

In a scenario where the existing Mistra grant or other potential funders would increase their support significantly (>5 million SEK/year), there are a number of strategic research initiatives that would significantly improve the capacity of SRC to influence the global sustainability science agenda and discourse. Initiatives that would be possible provided such funding, includes:

5.9.1. A synthesis platform

We envisage that a logical next step for SRC would be to increase our capacity to act as an international scientific convener, with an ambition to influence the agenda and focus of Sustainability Science worldwide. Partly inspired by the National Centre for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara (California, USA), we would develop a similar institutional hub for convening, facilitating and enabling global syntheses on social-ecological systems dynamics. NCEAS invites scientists to conduct global synthesis on issues of their choice, with a criterion that there is potential for publication in the highest ranked scientific journals. A difference that we envisage in a proposed similar function in Stockholm is that it would act as an interface where SRC research could be better connected to the larger world of sustainability science. The focus in this platform would be to conduct novel syntheses of social-

ecological systems, within the scope of the vision and mission of the centre, rather than opening up for any type of synthesis or research group. The Centre would carefully select world-leading researchers with relevant data sets on social-ecological systems dynamics, for series of workshops. Given that we can attract adequate funding, SRC would host a secretariat with a function to advertise and receive applications for synthesis-topics and carry out administrative and practical arrangements of synthesis workshops. This synthesis platform shall also be open for other actors in society – as policymakers and practitioners – with knowledge on relevant issues. This will enhance transdisciplinary approaches (i.e. beyond the academic knowledge system). The platform will also be part of the SRC's outreach undertaking. The Centre will host post-docs, specifically employed by the platform, whom will participate as “work horses”, including developing relevant data-bases, perform scientific analyses, and coordinate writing processes with the scientific leadership of the respective synthesis projects.

5.9.2 PECS+ (establishing network of SRC-like centres in the world)

In 2011 the International Programme Office of The Program on Ecosystem Change and Society (PECS) was established at the Stockholm Resilience Centre. PECS is jointly sponsored by ICSU and UNESCO and aims to integrate research on the stewardship of social–ecological systems, the services they generate, and the relationships among natural capital, human wellbeing, livelihoods, inequality and poverty. PECS will provide coordination, an overarching framework and a global focus for research projects that investigate the resilience and dynamics of social-ecological systems.

The principal approach of PECS research is comparisons of place-based, long-term social-ecological case studies. PECS will also develop and facilitate a set of dynamic, interdisciplinary working groups that focus on different cross-cutting topics. PECS will provide the mechanisms for a deep intellectual exchange among these diverse projects, case-studies and working groups on social–ecological systems.

Differences in the methods used are sometimes a barrier to comparative analyses of social–ecological research, yet diverse social–ecological systems often require different methods. A key part of the capacity-building strategy for PECS will be training workshops on core methods for place-based, long-term social-ecological research. Examples of such methods include qualitative analysis of narratives, various kinds of models, and scenario planning and resilience thinking. These workshops will address the variability in methods and standardize methods when this is appropriate. PECS will also sponsor broader workshops to develop cross-cutting themes that contribute to a wide range of research on social–ecological systems.

5.9.3 New and long-term research positions

A strategic goal for the SRC is to have a critical level (ideally around 40 percent) of core financial resources to coverage critical mass of permanent research positions. To reach this level, core funds for another about ten permanent research positions should be obtained.

5.9.4 A Swedish Future Earth initiative

Future Earth is an international initiative to advance earth system research for global sustainability. It emerges from the integration of large parts of the global environmental change programs under ICSU and its partners. It constitutes the largest interdisciplinary endeavour in the world of advancing integrated global sustainability research, building on a wide and well-established global community of scientists. SRC has been actively involved in supporting the development of Future Earth (which starts in 2013), and hosts two programmes within the Future Earth “family” (PECS and BioSustainability). There is a large opportunity for Sweden, through its broad and long-standing support to the science that forms the foundation of Future Earth (e.g., IGBP hosted at KVA; the Land use programme at Lund University; climate science through the Bert Bolin Centre; and SRC's engagement in Diversitas, IHDP, ESSP and IGBP). Together with Swedish academic partners SRC proposes to engage actively in Future Earth.

6. Education

Education is a central activity at the SRC that contributes to our mission by not only developing young scholars, but also serving as a platform that deepens our research, and connects our research activities to the larger world. Our overall goal is to establish a world leading resilience research school that develops young scientists who will create new approaches, insights and tools for biosphere stewardship and innovation.

Why do we do Education at the SRC?

- Enable great SRC-led student research
- Create the next generation of leading resilience scientists
- Improve the skills of researchers at the SRC
- Provide a platform for synthesis at SRC and with our partners
- Develop training and communication tools and resources
- Facilitate collaboration within SRC and with our partners

Since our establishment, the Stockholm Resilience Centre has established new programmes of novel social-ecological training at the Masters and PhD level. In our first five years, we replaced two Masters programmes, which we inherited, with a new successful Masters programme that we developed, Social-Ecological Resilience for Sustainable Development (SERSD). This programme not only trains young social-ecological researchers, but also integrates the various research themes through teaching and student research. Furthermore, we also founded the Resilience Research School, a training and research school for PhD and MSc students supervised by SRC staff.

Below we outline how we plan to develop the education programme over the next several years, by enhancing our education, strengthening our partners within Stockholm University and Stockholm, and building on existing international collaborations. We follow these immediate plans with proposed additional activities that could transform our education.

6.1 Step 1: Commitments

We plan to strengthen our education by improving our courses and programmes, enhancing the capacity of the SRC to teach, mentor and administrate education, build our educational collaborations and develop shareable educational resources. We discuss each of these strategies in more detail below.

6.1.1 Consolidating the Resilience Research School (RRS)

The next big step for the SRC is developing our research school to incorporate our new PhD programme in Sustainability Science within the faculty of natural science at SU, which was approved by the university in spring 2013. While SRC has previously provided academic support and training for our PhD students, we now need to provide formal research quality control, examinations, and general administrative support. Doing this requires developing clear administrative routines and requirements for RRS members, teachers and supervisors that are clearly communicated and monitored, but that support experimentation, innovation, and the development of new types of transdisciplinary research.

The research of SRC PhD students bridges the social and natural sciences, but because our PhD-programme will be within the Faculty of Science and restricted by the faculty to PhD students working primarily within the natural sciences. We have to ensure that the RRS continues to support RRS members receiving their PhDs from other departments, in particular those in the social sciences, humanities and law. This requires a structure of the research school that focuses on resilience in sustainability science while maintaining the flexibility required to work with a diversity of departments from the natural and social sciences which have different course and administrative requirements. We believe that working across multiple departments is vital to build trans-disciplinary collaborations and strong transdisciplinary

PhD students, but such flexibility and bridging also has an increased administrative cost by requiring more coordination and communication than is needed within a disciplinary PhD programme.

However, because only PhD with a natural science background can be accepted at the SRC's PhD education programme, this is a significant obstacle for our interdisciplinary mission. The optimal solution would be that the SRC could accept students from all disciplines into one common programme. This is not allowed under current regulations at Stockholm University, and we will therefore investigate the option of establishing a parallel PhD education program at the humanity-social science area (including the faculties on humanities, law and social science). This will entail even more administration and thus will require additional resources. A third alternative is to form a partnership with another organisation that can handle interdisciplinary PhD education more efficiently. We aim to have a solution in place within two-three years, depending on the options, including funding.

In this complex academic environment it is essential that we build a culture of cooperation and support, which is key for open collaboration and experimentation. To do this we believe that maintaining and enhancing a culture of trust and fun is absolutely essential. We also ensure that PhD students are connected to the core research activities at SRC and the overall SRC framework by ensuring that every PhD student is linked to at least one of our Research Theme groups.

We also have the intention to develop a flagship PhD course (open to non-centre PhDs) based on the textbook we are developing (discussed later under Educational Resources). This course would be led by a small team of SRC researchers but would involve many from the Centre. The focus of the course could shift from year to year based on the expertise of the course leaders making the course dynamic and adaptive.

6.1.2 Continually improve Master's programme SERSD

We will strengthen our new MSc programme by further improving the training offered and students taking this programme. The new Master's program, based on resilience in social-ecological systems is designed to strongly link to the scientific foundations of the SRC and involves a substantial part of the SRC academic staff. We aim to improve the content of this programme and our ability to offer high quality supervision and teaching. Our experience from offering the courses in the MSc, the growth of the centre, and growth of resilience in social-ecological systems research requires that we further take advantage of on-going research at the SRC, in particular urban ecology and economics, and enhance the research skill development of students, in particular research design and scientific writing.

6.1.3 Enhance capacity of education to function as an attractor at SRC

We will continue to develop education activities as platform for integration and synthesis within the SRC. There is synergistic potential between the communication, outreach, and research activities of the SRC with education, because the compression of complex concepts for their clear communication that education requires also can benefit other SRC activities. For example, teaching resources developed for education can be utilized as part of outreach, while videos and other introductory materials developed for communication can be used to supplement in-class activities. On-going research activities can be linked to teaching in order to enhance student's research training by engaging the students in the practice of research. For example, the SRC's regime shift data base project has included several student projects from the regime shifts component of the MSc programme. Training in transdisciplinary science requires not just competence in science, but also competence in communication and outreach.

Ensuring the integration of education with these other SRC activities requires coordination between outreach, education, and research that requires staff to dedicate their time to forge connections between people working in these different areas and to identify the opportunities that exist for synthesis and further development. The SRC plans to invest in education staff to facilitate these connections to both benefit education, as well as research, communication and outreach.

6.1.4 Enhance Internal SRC Capacity for teaching and supervision

We plan to increase the robustness of teaching and supervision at the SRC by increasing the number of people engaged, enhancing the complementarity of people's competences, and expanding our collective teaching and mentoring skills. Increasing the size of the teaching cohort will allow for the rotation of module and course leaders. By engaging people in contributing to the teaching, planning, and revision of our existing course modules, we will ensure that multiple staff members are familiar with the content of different course modules. Both of these strategies this will enhance the resilience of our teaching, enabling us to avoid courses being cancelled or not offered due to sickness, parental leave, or research conflicts.

We will further ensure teaching and supervision quality through a variety of training and support programmes. We strongly encourage the academic staff to take required university pedagogy courses. Additionally, to develop our individual knowledge and experiences, as well as a common mentorship culture we will also institute a peer education seminar *How to be a SRC Supervisor*, for informal discussion among SRC supervisors on key issues in teaching, research supervision, and mentorship. We will also ensure that we learn from the teaching experiences of our collaborators, within SU and internationally, to improve our teaching practices.

6.1.5 Increase collaboration at Stockholm University and within Sweden

In 2013, the SRC merged with the NRM group of the Systems Ecology Department and was placed within the Sciences Faculty at Stockholm University. The integration of the NRM group with the Centre also means that we will inherit their two 10-week undergraduate courses: we are in the process of developing and giving the new course *Urban Social-Ecological Systems*. We will also continue running the other very popular course, *Nature and Society*, but will most likely convert it to an online course, to reach beyond Stockholm University. The placement of the Centre within Faculty of Science clarified the situation of the Centre within the University and provides us with a platform to develop long-term connections with other departments within Stockholm University and actively pursue new opportunities for exchange of experiences, e.g., teaching pedagogy and course administration, both at Stockholm University and within the Stockholm region. We already have established research collaborations with KTH and SLU.

6.1.6 Increase internationalization and collaboration for MSc and PhD students

We will strategically develop a platform for activities to enable students to have more opportunities to meet and learn from their peers at other leading sustainability science research centres. There are many ways in which current PhDs and MSc students are connected with international collaborators of researchers at the SRC, however these initiatives are currently largely ad hoc. Since the Centre has grown these ad hoc arrangements become increasingly unwieldy. We therefore plan to develop a system to better manage our external collaborations in education. We see five specific activities to better achieve these goals:

- Development of loose planning systems to better integrate visiting researchers, especially long-term ones, into lecturing, seminar discussions and supervision of PhD and MScs
- Create a multi-week Introductory PhD course on resilience and social-ecological systems that explicitly aims to bring together SRC and external PhD students
- Build on success of short-term PhD courses to better foster collaboration with visiting PhD students
- Use EU Erasmus agreements to fund teacher exchanges with EU partner universities
- Build upon existing collaborations and within the Resilience Alliance to provide opportunities for student exchange and collaboration.

6.1.7 Develop Internationally Available Educational Resources

We will develop a textbook and other educational resources by integrating our existing course resources, with our communication and outreach material. Transdisciplinary research requires bridging research and practice and we have a great opportunity to develop transdisciplinary teaching and learning resources by combining the experience and work of the Resilience & Development programme who work to connect research and stakeholders, with our MSc and PhD courses where we seek to enable students to learn about social-ecological and resilience issues.

Developing such resources will contribute to the mission of the SRC by providing a basis for teaching and communication, but will also benefit those outside of the centre by providing a set of resources for others to teach and learn about the key social-ecological theories and methods. Current activities are:

- Development of a textbook based upon the MSc programme structure as a framework in collaboration with Prof. Lance Gunderson (Emory University, USA).
- Strategic development of online courses based upon our MSc programme to be able to reach students beyond SRC.

6.2 Step 2: Vision

Our overall goal is to establish a world leading resilience research school that develops young scientists who will create new approaches and tools for biosphere stewardship and innovation. Above we presented a variety of plans to build upon our existing strengths within our current plan. The activities below would require that new resources be devoted to education. We propose a set of four exciting activities that would build on existing and planned activities by strengthening the network of sustainability science and resilience researchers in the Stockholm region, incorporate resilience and sustainability training in undergraduate education within Stockholm, enhance our ability to offer transdisciplinary education, and establish SRC as a global node in sustainability and resilience training. We describe each of these proposals below.

6.2.1 Stockholm Resilience in Sustainability Science PhD student group.

We propose to reorganize the Transdisciplinary PhD Group at Stockholm University (the former CTM group) and explore the possibilities to establish a larger PhD/Postdoc level network in the full Stockholm region (there may be other criteria for membership). The first step is to consolidate our own PhD school according to the suggestions above. The next step would be to build a PhD programme like our Sustainability Science program, but with a basis in social sciences, the humanities and law to secure a resilient ground for our own SRC students and supervisors regardless of scientific background. We would then build a PhD group for other PhD students at Stockholm University as well as in the larger Stockholm region, including KTH, SSE and SLU. The new students invited into this group would not be primarily/necessarily supervised by SRC staff, but have a genuine interest in our perspectives. We could offer courses, research visits (e.g. sitting at the centre for a few months), development of joint “lab”-facilities, and regular seminar discussions on subjects that bridge their research areas within the SRC framework, experience and interests. We already have ad hoc collaborations with students from these universities, but this would be a way to improve and enhance our capacity to reach beyond our own network and contribute to both capacity building and long term collaboration with bright and interested graduate students.

6.2.2 Education of change makers at undergraduate levels

To more strategically contribute SRC sustainability and resilience perspectives to existing undergraduate-level education programmes, we can focus particularly on programmes where many of the future leaders and change makers are educated. The Stockholm School of Economics is a top-ranked university that educates a new generation of economists and business leaders, and many programs at the Royal Institute of Technology educate future engineers. These two groups have substantial influence on how the world develops and will continue to have this in the future, but lack knowledge and tools to analyse and

understand social-ecological systems and resilience. Leaders at these schools are interested in improving environmental aspects of education and partnership with these organizations offers the potential to substantially leverage the work of the centre.

6.2.3 Transdisciplinary Educational Support Staff

We seek to build an excellent staff that can organize courses and meetings, welcome visitors, and solve the many minor problems that impair the smooth operation of learning. A small, dedicated support group is essential to building a world-leading research school. We need ambassadors and science/practice diplomats who help connect the SRC to our academic partners in the Stockholm region and nurture relations with visiting researchers.

6.2.4 Training the next generation of academic leaders in the field

SRC sees as an important task to train the next generation of academic leaders in the research field of resilience and sustainability science. Currently we are involved in leading two international networks of young scholars. We would like to build upon this work by building a strong overarching partnership with leading research centres on sustainability science.

Several of the junior researchers at the Centre were involved in building the Resilience Alliance Young Scholars network that has become one of the most interesting developments in Resilience Alliance and an important platform with over 50 young scientists around the world. We are also involved in the recent development of the Beijer Young Scholars, a collaboration among SRC, Beijer Institute, Royal Academy of Sciences and Columbia Earth Institute that connects young economists with scientists from other disciplines in this field.

We are now in preliminary discussions with the Kennedy School of Government at Harvard, and with Columbia Earth Institute about building a global network of young sustainability science leaders via a Resilience Summer School. This would be a global gathering of a group of the top PhD researchers worldwide in resilience and sustainability – to improve their skills, collaborate, and network. The summer school would combine training, research and practice with art and exploration.

7. Bridging science, policy and practice

SRC is a scientific centre that advances sustainability science in support of change towards sustainable development. All approaches to new insights and mind shifts among practitioners and policy makers, or impacts on policy and business practices, emerge from the research processes, partnerships and science communication and dialogues that occur at the Centre. The quality and relevance of the research is the vehicle for sustainable change. In an iterative and integrated approach, linking scientists with stakeholders often as an integral part of the research process, SRC contributes to bridge science, policy and practice in five main ways (Figure 7.1):

1. Direct diffusion of scientific insights through scientific publication, meetings, education and training.
2. Research methods that also engage stakeholders in knowledge generation (transdisciplinary activities).
3. Interplay with policy processes on global, regional and local scales (e.g., Nordic Ministerial Council, Arctic Council, European Commission, UNFCCC, UN Rio+20 Earth Summit, UN CBD, IPBES, UN SDG/SDSN, Future Earth) through dialogues, syntheses and reports.
4. Slow diffusion of insights contributing to mind-shift through e.g. various forms of science-art-music concepts that enhance connectivity and understanding between science and practice; and
5. Conventional science communication/outreach and diffusion of knowledge and understanding.

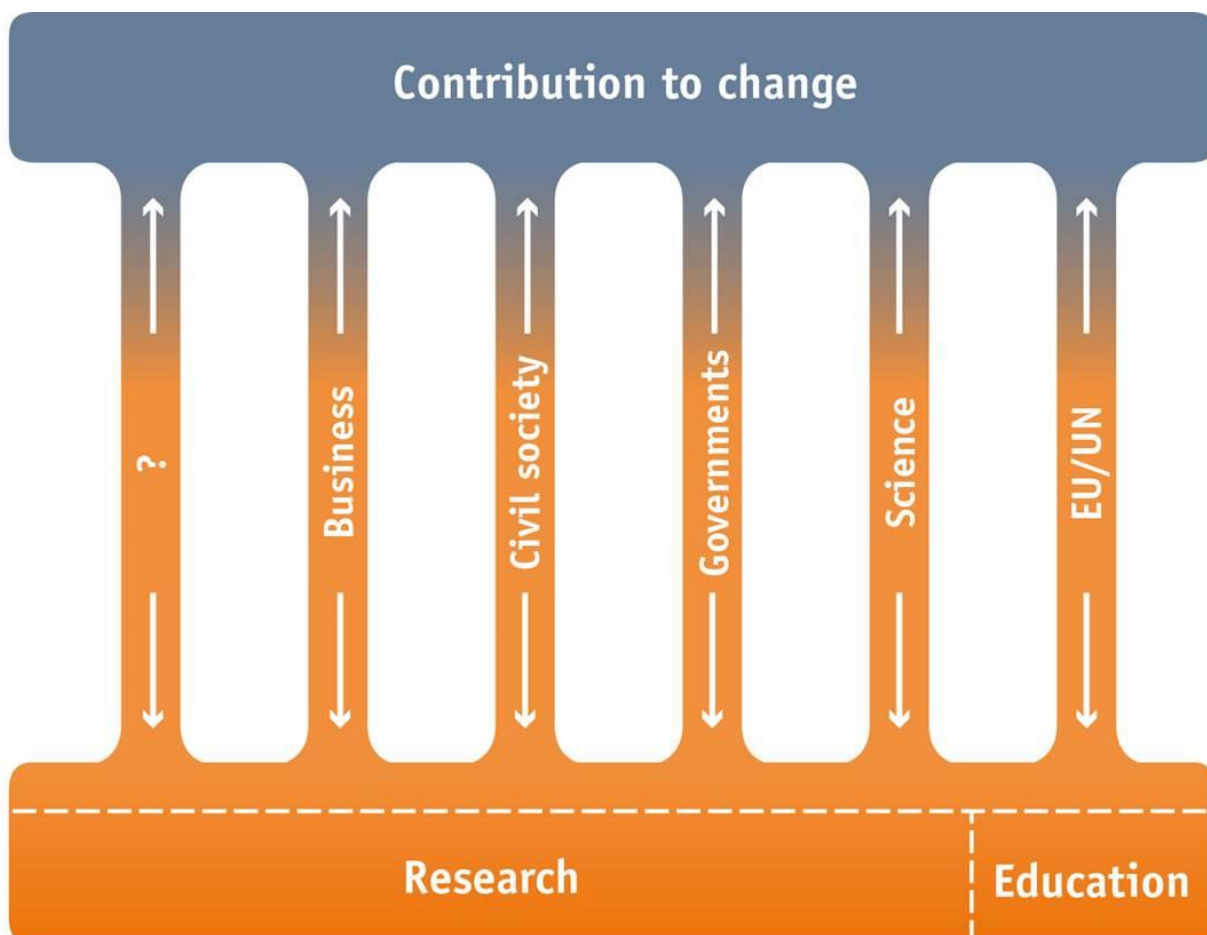


Figure 7.1: The role of the Stockholm Resilience Centre in knowledge generation for change, and how we weave together all parts of the Centre's activities (in science, education, dialogue, communication, administration and working environment). See main text for explanation of the pathways. Importantly, each pathway is reciprocal, with knowledge, insights and influence flowing both ways in an iterative dance, from science, and back into science.

The general evolution and strategy for the SRC in the area of bridging science, policy and practice can be summarised in three stages:

- (1) Engaging in existing science-policy-practice arenas (1st phase 2007-2009). When the SRC was established in 2007 the strategy was to invest in building the science-policy interphase by offering SRC science to existing arenas for dialogue and change (with the Tällberg Forum as a priority arena);
- (2) Develop SRC as its own international convener (2010 onwards). As a response to the recommendations from the Bill Clark evaluation at the end of the 1st phase of SRC, the strategy was and continues to be that SRC should increasingly function as its own convener, experimenting with different ways of raising science impacts (resulting e.g., in the Nobel Laureate Symposium sequential in Stockholm (2011), Durban (2011) and Rio (2012));
- (3) Invest further in experimenting with novel ways of raising science impacts through science, arts and business (proposed strategy for 2014-2018). SRC will continue to carry out basic science communication, strengthen trans-disciplinary research methods and build networks and partnerships of knowledge, as well as contribute scientific insights to established policy processes. A key priority forward is to invest further in connecting science, arts and business, as a strategy for science dialogue and impact.

7.1 Trans-disciplinary approaches to science impact

The strategy of the SRC has been to generate new scientific insights and to apply and develop them in policy, practice, industry and academia. In line with the SRC Vision and Mission, SRC's impact pathway is through the quality and relevance of its science. It is based on our research that all communication and science-policy-practice activities, and thus science impacts, occur. The Centre has successfully established itself as an international link between social-ecological research and strategically selected policy processes.

SRC is an inter-disciplinary research centre with a significant focus on advancing trans-disciplinary research approaches that involves stakeholders in the research process. This means that the scientific work at the Centre is tightly coupled with its work on communications and in bridging science, policy and practice, which is considered integral to the process of knowledge generation. Over the course of SRC's development, the role of local and regional impacts of its research has increased in importance, and is largely accomplished through stakeholder engagement in the research process. This strategy of integrating science with communication and engagement will continue to evolve further during the next phase. Moreover, the SRC wants to develop a deeper understanding about the relationship between such strategies and organizational structures and processes (our "way of working") and specific impacts.

7.2 Evolving towards own convener

Based on the recommendations from Bill Clark's evaluation of the centre in 2009 and subsequent actions taken by the Centre board, SRC has moved from operating as an institution relying only on other conveners of policy and practice dialogues, to instead invest more actively in being our own convener. We intend to strengthen further our scientific support to policy makers and practitioners, by increasing our role as a convener of processes for bridging science-policy-practice.

A particular emphasis for the SRC over the coming five years will be to invest further in experimenting with new ways of generating science impacts by linking science with arts and science with business. We are making plans for a larger unconventional event to take place in 2016.

7.3 Bridging science with policy

SRC will continue to engage actively in a few key science-policy processes at the local, regional and global scales that are relevant to the SRC science agenda.

7.3.1 International processes

These processes include:

- Follow-up and implementation of the UN Millennium Ecosystem Assessment (MA)
- Contribution to the establishment of the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES)
- Close partnerships in the forming and implementation of multilateral environment agreements related to the work of the United Nations Framework Convention on Climate Change (UNFCCC), the UN Convention on Biological Diversity (CBD) and the UN Food and Agriculture Organization (FAO)
- Participation in processes related to poverty and development, including the Millennium Development Goals and the 2012 UN Conference on Sustainable Development (RIO+20)

The Centre contributes on all levels, be they local, regional, national or international level. Examples of such work includes the Man and Biosphere Programme, where the centre partners with institutions such as UNESCO to develop new insights on biosphere reserves and how to improve on-the-ground management of ecosystem services.

Key priorities will be given to the following agendas:

- IPBES, TEEB and UN CBD, on the links between biodiversity, ecosystem services, resilience and human wellbeing.
- The follow-up of the UN Rio+20 process of transforming the UN Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs).
- European Resource Efficiency Platform (EREP) and other EU processes towards regional and global sustainability and a circular economy.
- Support the international UN processes within the Rio Conventions on Climate Change (UNFCCC), Biodiversity (UN CBD) and Desertification (UN CCD).

The means by which this will be accomplished will vary, including several of SRC's present engagements. Through the SRC Resilience and Development Programme (Swedbio), which contributes to the exchange and co-production of knowledge between various knowledge holders and practitioners, the Centre will be able to continue linking science to policy on ecosystems and poverty alleviation. SRC is represented in the UN SDG process by being a member in the Sustainable Development Solutions Network (SDSN), which has been established by UN Secretary General Ban Ki-moon as a global knowledge network in support of solutions for the implementation of sustainable development. SRC is actively involved in the UNESCO Man and Biosphere program, which connects knowledge systems on sustainable management of landscapes and seascapes from local to regional scales.

SRC has together with the secretariat of the CBD and ICLEI (Local Governments for Sustainability) organized a Global Partnership for how the Aichi-targets could be incorporated in policy and action by local governments around the world. The Global Partnership involves the major UN-organizations, UNEP, UN-Habitat, Unesco, FAO, Ramsar and a large number of cities and research institutions around the world and includes: a) major analysis of how global urbanization is affecting biodiversity and ecosystem services, Cities and Biodiversity Outlook, published in two parts CBO- Action and Policy launched at COP11 in Hyderabad 2012, and CBO-Scientific analyses and assessment, published by Springer in 2013. Both volumes have been edited by scientists at SRC, b) development of a specific set of indicators for monitoring of biodiversity and ecosystem services designed for the local level CBI, where SRC has been

giving scientific advice. These activities represent an exciting initiative by a global convention of reaching out to the local level and engaging local governments and citizens in the implementation and development of the convention's sustainability agenda.

As a follow-up to the challenging efforts of advancing financial mechanisms for valuing ecosystem services, SRC initiated the so-called "Quito dialogue" in 2011, which through a multi-stakeholder dialogue opened up a pathway for a common approach to financial mechanisms. Now, SRC is in dialogue with both Swedish and Norwegian governments to host a Quito 2 over the coming 1- 2 years, with the purpose of further strengthening evidence based policy support on financial mechanisms. The SRC-hosted PECS programme will increasingly evolve into a platform for comparative science-policy dialogues linking regional social-ecological strategies for resilience building.

7.3.2 Swedish processes

SRC will continue to be actively involved in supporting science-policy bridging in Sweden, through dialogues, science reports, wider science communications, and engagement in various science-policy processes. SRC is represented in the government's Science Committee on the Environment (Miljöforskningsberedningen, which is advisory to the Minister for the Environment) (2012 onwards) and the Scientific Committee on Biodiversity ("Vetenskapliga rådet för biologisk mångfald", housed at the Swedish EPA). Moreover, SRC was represented in the Swedish Government's Futures Commission, which ended its term in 2013.

During 2013, the SRC was deeply involved in a study commissioned by the Swedish Parliament on how to visualize and govern ecosystem services for human wellbeing (from economic valuation to stewardship). Maria Schultz was the commissioner, appointed by the government. We foresee an important opportunity to follow-up, during the next SRC phase on evidence-based support to internalizing ecosystem valuation in regional to national policymaking. SRC also hopes to be represented, on behalf of Sweden, in the scientific committee of IPBES, and continue to support the Swedish government's work within the context of the UN CBD and IPBES.

7.4 Programme development, networks and partnerships

As part of SRC's trans-disciplinary research approach, co-design and co-production of knowledge together with key stakeholders will continue to be an integral part of SRC's "work model". In order to succeed SRC will, apart from engaging in various initiatives to bridge science-policy-practice, also continue to invest in developing and contributing to science based networks and programs that contribute to bridging science-policy-practice.

The Resilience and Development programme (formerly known as "Swedbio", now "ResDev") plays a critical role in advancing a resilience-based approach to poverty alleviation and sustainable development. This programme will transition into a 2nd phase at SRC in 2014, and the aim is to position the "ResDev" programme even stronger as an international provider of knowledge on resilience strategies for sustainable development, with links both to local development projects and to international policy processes.

The SRC has one of its roots in the international science network of resilience scientists within the Resilience Alliance. SRC is today a key node within the RA, not least through the coordination and leadership of its young scientists' network, the RAYS (RA Young Scholars). SRC will continue to engage in the RA as one of its key priority science networks in the world.

From 1st of January 2013, "Future Earth", a new international initiative to advance integrated earth system research for global sustainability, has started to operate under the auspices of an alliance including ICSU, ISSC, the Belmont Forum, and several UN agencies (UNEP, UNU, UNESCO, WMO). Future

Earth will integrate several of the current global environmental change research programs under ICSU (ESSP, IGBP, Diversitas, and IHDP) into a major science endeavour for global sustainability. SRC today hosts PECS and BioSustainability, as well as being a co-host of IHOPE, which all form part of Future Earth. The SRC engagement in the science and the science-policy-practice as well as capacity development within Future Earth will be a priority in the coming years.

7.5 Moving beyond conventional communications

SRC has made it a trademark to see communications as an integral part of the scientific process and a strategic priority for the success of the Centre. Experimentation with novel ways of communicating is a cornerstone of this strategy, which includes the development of a wide spectrum of different communication methods, from “whiteboard seminars”, “speed talks” to streaming of a range of guest lectures at the Centre. SRC will continue to place a very high priority on science communication to a wider audience (with a target remaining towards agents of change in society).

Science communications, based on methods to reach out with scientific findings to a wider audience, will continue to be a core priority for the Centre (with plans to strengthen the SRC science-media interphase). The aim is to continue strengthening the Centre’s capacity to draw out syntheses and insights from different strands of research, as a way of communicating systemic evidence based conclusions.

SRC has made several efforts of working with arts, music, film and photography as a way of raising the communicative value of the research carried out at the centre. This will become an even higher priority 2014-2018. One component of this strategy will include “story telling” through popular science articles, films, exhibitions (e.g., through articles in journals like National Geographic and “Forskning och Framsteg” in Sweden).

SRC will furthermore continue to build a local and international Alumni of young scholars (students graduating from the SRC MSc program, Världens Eko, and PhD programme; the Resilience Alliance RAYS program; the Beijer Young Scholars program) and SRC partners, as a “slow variable” of communicating SRC insights.

The target audience for SRC’s science communication is agents of change in societies, i.e., primarily decision makers and leaders in government, among communities, business, and civil society. Still, SRC will continue to work actively with science-media, and social media communications that have spill-over effects to a wider audience. Similarly, projects like “the Human Quest” that links SRC science with photography, reaches out to both decision makers and a wider public.

A strategic priority to raise the impact of the SRC communications work is to continue develop partnerships with individuals and groups that can amplify our scientific insights (e.g., collaboration with research groups such as Gretchen Daily’s Natural Capital Project at Stanford University and with the World Business Council for Sustainable Development, WBCSD).

7.6 Exploring new forms of dialogue

In the phase starting 2014, SRC aims at raising further its science impact by exploring new forms of dialogue including science-arts and science-business, as well as advancing a proposed platform for science based high-level dialogues on global sustainability, “the Stockholm Dialogue”.

7.6.1 Science Arts

SRC has experimented with science-arts throughout its first and second phase. The Resilience 2008 conference (hosted by the SRC together with the Resilience Alliance) had an international arts competition and exhibition as an integral part of the science conference (organised together with the Royal Swedish Academy of Science and the Royal Swedish Academy of the Fine Arts). Over the years, SRC has hosted several events featuring music (e.g, the Coral Guardians initiative on coral reef stewardship

together with Soprano Saxophonist Anders Paulsson), and integrated music, theatre, and culture in its high-level science dialogues (e.g., events at the Royal Dramatic Theater and the Stockholm Opera, and Eric-Ericsson Hallen with specially composed choir pieces with Gustaf Sjöqvist Choir during the Nobel Laureate Symposium in Stockholm 2011).

A key science art project of the SRC is the publishing in 2012 of “The Human Quest” (THQ) which is a scientific summary of SRC research on global sustainability, carried out together with National Geographic photographer and filmmaker Mattias Klum. THQ was used as a “science communicator” from the SRC during the UN Rio+20 Earth Summit, as an integral part of the SRC and Ban Ki-moon High-level Panel (UN GSP) hosted Nobel Laureate/Global Sustainability Symposium in conjunction with the Summit. During 2013-2015 THQ will be used as a basis for experimental science-arts communication, with the intention of exploring novel ways of using science and arts to convey deeper resilience research insights (theatre, film, exhibitions, music).

7.6.2 Science Business

A strategic priority is to develop further the scientific dialogue with business, ranging from collaborative partnerships, the new SRC international advisory board (with business leaderships providing strategic advice on how SRC can further improve its relevance and progress), to the newly established collaboration with WBCSD (MoU signed in 2012). The WBCSD partnership is aimed at exploring various ways of bridging SRC science with business leadership; on how resilience thinking influencing business thinking, integration of planetary boundaries thinking into the long term vision of the WBCSD, and executive training on global sustainability and business.

The SRC newly established International Advisory Board (IAB) gathers leading business executives to provide strategic advice on how SRC can further raise its science impacts, and improve the interaction with businesses across the world. The SRC IAB will furthermore support SRC’s endeavour to secure long-term core funding.

7.6.3 Stockholm Dialogues

Already in the original proposal in 2006 to establish the SRC, a platform for science-policy-practice dialogue was proposed (the Stockholm dialogue on global sustainability). It is only in the 2nd half of SRC’s 1st ordinary phase (2010-2013) that SRC has started to experiment with this idea (through the Nobel Laureate Symposium; the Quito Dialogue).

During this next phase the SRC aims at developing the “Stockholm Dialogue” as a strategy platform for bridging SRC science with policy and practice. Ingredients of this dialogue form is to combine (i) SRC scientific insights and syntheses, (ii) innovative forms of interactive dialogues, (iii) engagement of key stakeholders from multiple backgrounds, and (iv) creative environments where science, art and music forms an integral part of the dialogue.

The SRC will continue to development its key strategic collaboration in science dialogues, including in particular the WBCSD, the CGIAR (through the Water, Land and Ecosystems program), the World Economic Forum (WEF), Future Earth, key UN agencies, and business networks.

A strategy may furthermore be to increasingly invite to science dialogues with key-stone actors in different sectors of focus within the SRC (e.g., the 10 most important actors in the world on fisheries, food, insurance, Mayors in large cities, etc.), as a way of advancing a deeper reciprocal dialogue on advancing novel ways of solving existing and emerging challenges.

The ambitions, here framed as Stockholm Dialogues, may be merged with the ambitions of establishing a more visible platform for knowledge syntheses, mentioned in section 5.9.1 in this document.

7.7 Internal communication and culture building

Successful external communication is impossible without a well-functioning internal communication. The Centre has invested significantly in developing open, creative and attractive working and learning environment that encourages transdisciplinary research.

The Centre's annual "rituals", such as the excursion to Stora Karlsö that includes all staff, internal seminars and other social events, constitute a fundamental part of creating this environment. The Centre is an appreciated host for a variety of seminars and events that meet the needs of the organization. Internal seminars such as the Resilience Dialogues and the Brown Bag Seminar series provide staff and students with the opportunity to continuously develop transdisciplinary skills and to test and discuss ongoing and potential research.

The Centre has further invested significantly in establishing an internal monitoring and reporting system in order to keep track of its development, make use of it in developmental evaluation, annual reports, external evaluations etc. There is an explicit intention to further develop these routines for data extraction on a regular basis in order to secure a consistent overview of all science and policy related work conducted at the centre.

8. Institutional development, leadership, management and working culture

8.1 Permanent institution at Stockholm University

The Stockholm Resilience Centre was started 2007 after a successful application on a call in 2006 from Mistra to establish an interdisciplinary research centre on sustainable governance and management of linked ecological and social systems. The founding organizations of the Centre, which collectively responded on the Mistra call, were Stockholm University together with the Stockholm Environment institute (SEI) and the Royal Swedish Academy of Sciences (KVA) through its Beijer Institute of Ecological Economics. The Centre was from the start part of the Stockholm University organization, and the university is also the employer of the staff. Initially the Centre was, as the only research unit, placed above the faculties, directly under the Vice Chancellor. However, the Vice Chancellor did propose that the Centre should be part of the regular organization and thus placed under a faculty. The main argument was that the SRC otherwise was isolated from strategic discussions, decision-making, fund-allocations, faculty elections etc. Given this decision, the SRC's choice was the Science Faculty. However, both the Science Faculty and the Social Science Faculty stated that they were not suitable to house the SRC. Partly because of this, the Vice Chancellor commissioned the two Deputy Vice Chancellors, who are responsible for the two research areas at Stockholm University, to review the placement of SRC within the SU organisation. They proposed the Science Faculty to be the most suitable placement. In December 2012 the University Board made the decision that the SRC shall be placed at the Science Faculty and they also endorsed the set of conditions for SRC integration in the Faculty that was given in the proposal from the Vice Chancellors, which accompanied the proposal of placement.

Hence, from 1 January 2013 the SRC is part of the Science Faculty of Stockholm University. The Centre is formally not a member of any of the four sections of the Faculty, but it is represented in the preparatory committee of two of them; the Biology Section and Section for Earth and Environmental Sciences. Since the start of the SRC, the ambition has been to become permanently established institution. Given the positive development academically, the growth of number of staff and the large financial turnover, the early ambition of becoming permanently established has successively been strengthened. This new

placement, implying establishment in the regular organization and embracement in the internal funding structures of the SU was a final step in this establishment.

Linked to the decision of new placement of SRC within the Faculty of Science, was also a move of the unit of Natural Resource Management (NRM) at the Department of Systems Ecology to SRC, which further confirm the permanency of SRC at Stockholm University. Simultaneously with the move of NRM, the Baltic Nest Institute (BNI), which was an integrated part of SRC research on marine social-ecological systems, was moved from the SRC, to form a new Baltic Sea Centre at Stockholm University. SRC has also, during 2013, formally been given the right to examine PhDs and SRC has its own subject of research education (*forskarutbildningsämne*), namely “Sustainability Science” (*Vetenskap för hållbar utveckling*).

8.2 Centre organisation and management

The organization and management of the SRC has a basic structure that has been constant during the course of time, including the international board and its task. Other aspects of the management and organization have been developed in parallel with the growth and development of the SRC. Examples are strengthening of the leadership capacity by hiring a Deputy Director/COO in 2009 and the appointment of two Deputy Science Directors in 2013. The governance, leadership and management of the Centre will in the period to come be organized as of Figure 8.1. In the start-up phase, the administrative and leadership capacity of the Centre lag behind the fast growth. These ‘growing-pain’ problems have since long been dealt with, by extending the executive leadership team and by establishing a full-fledge administrative support unit. The partly new organization, as outlined here, is well adopted to handle the management of SRC in the years to come.

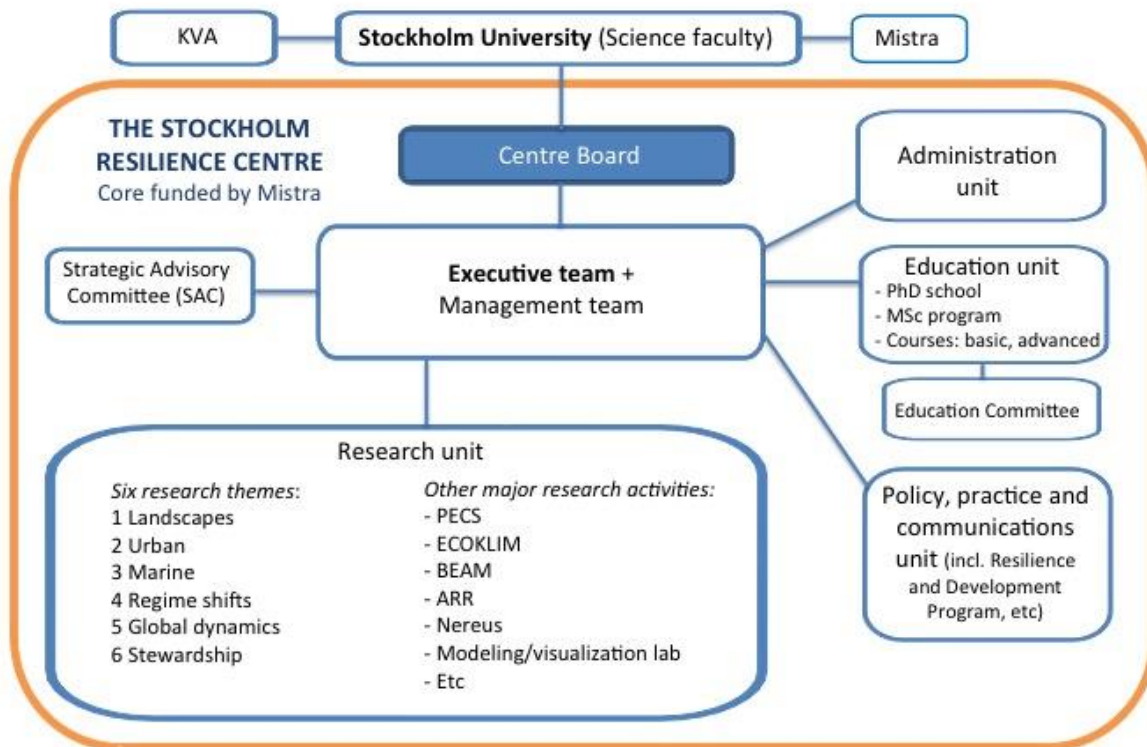


Figure 8.1. Organization chart Stockholm Resilience Centre 2013

International Centre Board:

In line with the instructions in the original Mistra call, and stated in the agreement between Mistra and Stockholm University, the SRC has an international Board of Directors. The Board is mainly populated with international researchers. The board will from 2014 be complemented with a representative for the students. The Board's previously two representatives from Stockholm University from 2014 are extended to four, two from the Science Faculty and two from the area of Humanities and Social Science. This Centre Board nominates (for decision by the Vice Chancellor for three year periods) the Centre Director (*föreståndare*) and Assistant Centre Director/Science Director (*ställföreträdande föreståndare*) – presently Johan Rockström and Carl Folke. The Centre Board also decides on the annual budget and on the strategic focus of SRC's operation, including research, education and communication. The Centre Board shall from 2014 and onwards meet at least four times a year. To have an international Centre Board that has the uttermost responsibility for the Centre's management is a key feature of SRC and shall remain so also beyond the next phase of Mistra funding.

Executive Team:

Johan Rockström and Carl Folke constituted the Executive team from the start in 2007. In 2009 it was extended by Olof Olsson, Deputy Director, to increase the management capacity and thus ease the initial growth-pain. From 2013 the Executive team has been extended with three new leadership functions of the Centre, namely Line Gordon and Henrik Österblom as Deputy Science Directors and Thomas Elmquist as Director for Resilience and Development Research. The Executive team meets once a week.

Management Team:

The Management team is mainly constituted by the heads of the operational units of the Centre, including the Administration (Emina Muratspahic), the Education (Lisa Deutch), the Policy, practice and communication units (Sturle Hauge Simonsen) and the Resilience and Development Program - SwedBio (Maria Schultz). The Executive and Deputy Directors (Rockström and Olsson) are also members. The Management team meets once a week.

Strategic Advisory Committee (SAC):

The SAC meets once per month to discuss strategic management issues, on which they give advice to the Executive team, e.g. on staffing strategies, new research efforts, policy/practice engagements etc. As research is the core activity of the SRC, research representatives dominate the SAC. In addition to the Research Director and the Deputy Research Directors, the six research themes collectively have three seats in the SAC. The theme leaders decide themselves who shall represent them in SAC. Other functions that are represented are fundraising, research school etc.

- Executive Director (chair)
- Deputy Director
- Science Director
- Deputy Science Directors
- Three Theme leaders, representing all themes
- Head and Senior Advisor of Policy, Practice and Communication Unit
- Head of Education
- Chair of PhD Education
- Head of Administration
- Director of Resilience and Development Research
- Director of the Resilience and Development program (SwedBio)

Operational units:

The SRC is divided into five operational units (the staffing of these units is presented in the Annual Reports):

1. Research unit; lead by Research Director Carl Folke and Deputy Research Directors Line Gordon and Henrik Österblom. This unit is by far the largest and it is divided into six research themes (see section 6 below). It also contains other research programs and networks that SRC is host for or is member of, as PECS, EkoKlim, BEAM, ARR etc.
2. Policy, practice and communication (PPC) unit; Head Sturle Hauge Simonsen.
3. The Resilience and Development (SwedBio) program; Director Maria Schultz.
4. Education unit; Head Lisa Deutsch
5. Administration unit; Head Emina Muratspahic

Including the meeting of these key strategic and management functions, over-time a collection of regular management meetings has evolved within the Centre which reflect a genuine demand for management ‘institutions’ at different levels and for shifting purposes. They represent different constellations of staff and others and have the purpose of sharing information, planning, decision-making etc. In Table 8.1 these different meetings, that serve important functions in the management of the SRC, are listed. The judgment is that the present set up serves the management of SRC well and there are no needs for major changes in the years to come.

Table 1: Meetings related to management

Meeting	Participants	Purpose	Frequency
Centre Board	Board members and leadership	Strategic advice, decisions on budget and Action Plan	Four times per year
Executive Team	Leadership (JR, CF, OO, HÖ, LG, TE)	Update, planning	Weekly
Management Team	Heads of units, JR, OO	Update, planning	Weekly or on demand
Strategic Advisory Committee	Leadership, research representatives, heads of units,	Advise to the leadership on strategic strategic management issues	Monthly
Staff meeting	All SRC staff	Updates - Top down and bottom up	Weekly
Staff retreat (3 days) Stora Karlsö	All staff: SRC+Beijer	Have a good time together. Fertilizing working culture	Annually
SRC (half) day	All staff: SRC+Beijer	Talking with an agenda	0-2 times per semester
Teaching and supervision collegium	All researcher	Strategic advise and update on teaching and supervision (MSc and PhD)	1-2 per semester
Unit and sub-unit meetings (Research, Adm, Com, Edu etc.)		Update, planning	

8.3 Intellectual working environment; the SRC culture

The management philosophy of the Centre is to have a sound balance between top-down and bottom-up initiatives. From the start and onwards, the balance has gradually shifted from a top-down dominated approach, to more and more opening up for bottom-up management, as the organization has matured. Moreover, in the early days the relative small size of the Centre made it possible to have an on-going dialogue among the researchers and between the researchers and the leadership without particular “institutions” for this. However, over time as the Centre has grown, this flat, efficient, and easy-going management approach has been harder to maintain. The employment of a Deputy Director was a first step in increasing the capacity and important new management innovations are the appointments of (1) two Deputy Science Directors and (2) a Director for Resilience an Development Research, from 2013 and onwards. The appointment of the Deputy Science Directors is a critical step for developing the bottom-up approach and for facilitating the cooperative working mode of the SRC. In a growing organization, this function is an adaptation to maintain a good dialogue between the leadership and researchers. The

Deputy Science Directors will regularly gather a group consisting of one representative from each research theme (chosen by the members of each theme). This Theme Leader Group meets and share information among the research themes, discusses cross theme activities and new research endeavours. The Deputy Science Directors and the new Theme Leader Group thus serve as a key function in (1) coordinating and sharing information among the research themes and (2) relaying vital information between the researchers and the leadership.

The appointment of the RDR Director is important for coordinating and evolving the research linked to development issues and for further merging of the Swedbio program with the Centre's research. In late August the two last years, Centre staff of all categories, including staff at the Beijer, have made a three-day field trip to the island of Stora Karlsö in the Baltic Sea. More than 80 staff members have participated each time. The main purpose has been to get to know each other better, being social, having fun, building trust without a demanding agenda. Another important thing is to discuss Centre commonalities beyond the day-to-day work; our common history and future – the SRC culture. The trips have been very appreciated by the staff and it will be institutionalized as one of a few annual events serving to maintain the SRC culture.

The research at the SRC is organized in six themes and a few other research programs or activities, which also are integrated with theme activities. This theme structure is an important sub-unit not least from an organisational and administrative perspective. For example the PhD students do belong to a theme where they find a sub-unit of more senior researchers that they can interact more closely with. The research organization is further elaborated in chapter 5. A lot of the research at the Centre take, however, place also across themes and not least in collaborations with individuals and groups outside the Centre, nationally and internationally. The norm is that all research undertakings are done in short or long lasting temporary constellations or teams, which often self-organize for the question in focus. But they never remain for their own sake, only as long as they are creative and productive. Almost all research are initiated by the researchers themselves (e.g. bottom-up) and based on a genuine and curiosity-driven search of new knowledge and understanding. Yet, a lot of the work is highly relevant for, and demanded by, practitioners and by policy makers, on different aspects of how to manage social-ecological systems in a sustainable and resilient way. A strategic challenge for the Centre is to keep the SRC culture of working together when the number of staff is growing. We believe there is an upper limit beyond which the uniqueness of SRC is diminishing (this further elaborated below).

Although the research is initiated bottom-up, the SRC has a clear framework for the research; see also chapter 5. As a balancing force to the free bottom-up approach, the leadership gather all members of the theme leader groups at a retreat one or two times per semester to revitalize the comparative advantage of working together, which is vital for the SRC's research culture. This is fundamental, as research clusters inevitably tend to drift apart after some time; illustrated in the first panel in Figure 8.2. If this goes too far, SRC will lose its comparative advantage. The revitalization, including identification of new promising areas of research and prioritisation, but also including rejections, is illustrated in panel 2 and 3, followed by the reorganized research clusters in panel 4, which imply a very productive phase of highly relevant research. Then, again, after some time the clusters tend to drift apart, as in panel 1, and the loop starts again. These retreats gather around 20 theme leaders each time and are very appreciated. The "SRC insight albums" are example of products from the retreats.

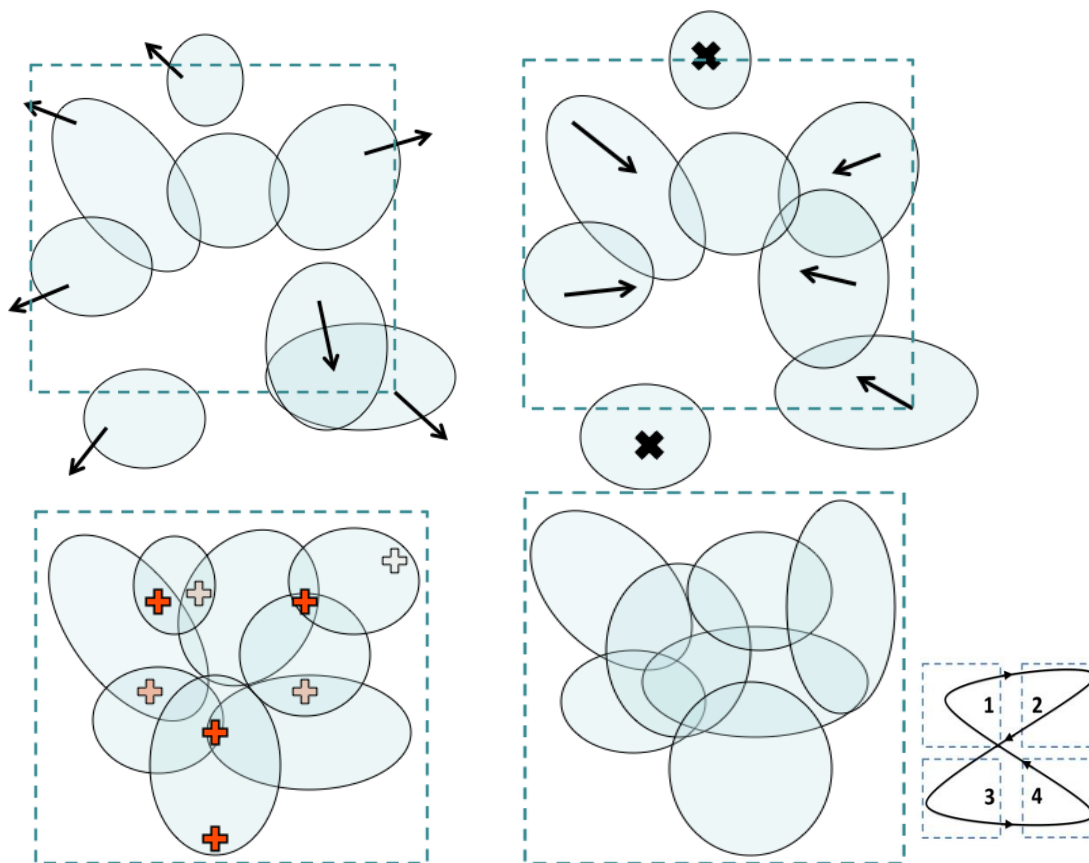


Figure 8.2. Revitalizing the “working-together” mode, which is a comparative advantage vital in the SRC’s research culture. Research clusters inevitably tend to drift apart after some time (panel 1). Revitalization, including identification of new promising areas of research and prioritisation, but also including rejections (panel 2 and 3), followed by the reorganized research clusters (panel 4), which imply a very productive phase of highly relevant research. After some time the clusters tend to drift apart again (panel 1), and the loop starts again.

Besides the retreats with the theme leader group, the SRC has a ‘tool box’ with a number of different meetings which are supporting the interchange of ideas within the Centre and external partners. These are listed in Table 2. For organizing these activities, SRC has a one person responsible for supporting these activities. The synthesis platform, that is proposed in chapter 5 above and which is to be developed, is an extension and builds on this process.

TABLE 2: Meetings related to research and working culture

Meeting	Participants	Purpose	Frequency	Comment
Speed talk lunch	All staff: SRC+Beijer	Four minute updates	Weekly	Combined with staff meetings
Theme leader group retreats	(Leader groups from each theme, leadership etc. (ca 25 pers)	Focusing the SRC research agenda. Identifying cross theme and centre wide research issues	0-2 times per semester	When motivated
Resilience Dialogues	SRC+Beijer research staff	In-depth discussions on key research concepts & new topics	1-2 times per month	Purpose designed. Presentations, group discussion.
Brown-bag seminars	All staff: SRC+Beijer	Ad hoc presentations by staff and visitors	Lunchtime (often several each week)	Self organizing
Stockholm seminars	All staff: SRC+Beijer	High profile academic talk by distinguished guest	Approx 7-10 annually	Held at the Royal Academy of Sciences
The Stora Karlsö Retreat	All staff: SRC+Beijer	Nurture SRC culture	Annually	
Stockholm workshops	Mix of staff and international researchers	To add competence and to manage international networks	On demand - several per year	Collaboration with local partners, especially Beijer
Theme meetings/ activities	Theme (or other research group) members	Working meetings	1-3 per semester, but frequently on demand	Each functional research unit has their own internal meetings

8.4 Size and institutional development

The SRC has established itself as a relatively large institution in the area of sustainability science. In 2013 altogether about 140 individuals did have the entire, or part of, their salary from SRC. This includes all staff of the Beijer Institute, also a few individuals that have no salary from SRC, as the operations of two organizations are totally coordinated (several individuals at Beijer have part of their salary also from SRC as they are members of SRC's theme leader groups). The most recent details of distribution of staff in different units and their work titles are found in the SRC's Annual Reports. Because several individuals do have only part of their salary from SRC, the number of full-time equivalents is almost 100.

Throughout the evolution of the Centre, there has been an active discussion on how to balance two partly opposition forces; (1) on the one hand the need to build a critical mass of inter-disciplinary researchers, communicators, educators and support staff to match the mission and vision and scientific agenda of the Centre, including the growing demands for SRC know-how (an argument for growth), and (2) on the other hand the challenge of continuing to nurture a cooperative culture of inter-disciplinary research based on the sharing of a common science framework, trust and incentives for team oriented problem-based learning and open access to knowledge frontiers.

In 2012, the number of full-time employed graduated research staff was about 40. In addition there were 10 postdocs and about 20 PhD students. To this we can add about 30 affiliated research staff (researchers part-time paid by the SRC) of different categories. This adds up to over 100 individuals that form the inner circle of SRC research staff. These in turn cooperate on a regular basis with researchers in international networks, which involve several hundred individuals.

The targets of growth set out in the 2010-2013 Action plan on permanent research positions, is well surpassed. In early 2013 the SRC had 13 full-time employed senior research staff: five professors and eight docent (docent is a personal Swedish academic title between PhD and professor, earned after faculty lead peer review, similar to Am. Associate Professor or Eng. Reader). The goal for the next five-year phase is to have another five professors and another five to ten docents. This will be achieved chiefly by career advancement of existing staff, but to some extent also by recruitments. It may also involve collaborations with additional academic partners.

It is difficult to assess the optimal size of a centre like SRC when considering the two factors mentioned above: (1) need for growth versus (2) how to maintain the cooperative culture within one scientific framework. Our assessment is that the SRC is approaching the ceiling for the best possible balance between (1) and (2). If we move very far beyond an inner circle of about 100 graduated research staff, it will become increasingly difficult to maintain a flat organization, well-adapted to stimulate inter-disciplinary sustainability science. On the other hand, our assessment is that there is a large opportunity for SRC to contribute further to the international frontier of sustainability science. In order to address this we suggest the following strategy for the next phase:

1. Careful increase in the number of senior or mid-career, research staff with up to ten individuals.
2. Expand the capacity of the SRC to deliver new knowledge largely by allowing the SRC research school to grow (add young scholars among MSc students, PhD students and Postdocs researchers). Another ten (totally 20) postdocs and another 20 (totally 40) PhD students seem passable.
3. Invest further in SRC's role as an international convener for visiting scholars, science networks, and science syntheses in sustainability science
4. Actively support the evolution of, and partly amalgamate with "SRC-like" scientific nodes in the world (i.e SARAS Uruguay, PECS South Africa/Stellenbosch, the Natural Capital Project Stanford University and possibly the new Santa Fe-styled systems research centre at NTU in Singapore).
5. Expand SRC in modules that involve other academic partners in Sweden

8.5 Recruitment strategy

The strategy of the SRC of recruiting research staff includes partly different priorities for different phases of developing the centre. The Stockholm consortium (Stockholm University, Beijer/KVA and SEI) gained the competitive Mistra call grant because its research agenda was developed far ahead of its competitors and because it already had a critical mass of young and talented researchers within the focus of the call. A strategically important task in the start-up phase of the SRC was therefore to secure, on full-time contracts, a core group of these key individuals with unique competence in the research area and the mandate of the SRC. These individuals still constitute a significant part of the core group of theme leaders and are a key factor for upholding the trustful, collaborative working culture of SRC. In parallel, at the start-up phase, the Centre opened up for some international competitive recruitments, including the appointment a senior social scientist from abroad. An early complementary strategy was also to link established senior researchers from several fields on part time contract to the centre, to accomplish a wide range of disciplines.

Of the total research staff (professors, senior lecturers, associate senior lecturers, researchers, postdocs and PhDs) recruited and employed on long-term and short-term contracts since the start in 2007, about 75% are external (degree, background training or previous employment from elsewhere than the Department of Systems Ecology, SRC, Beijer or SEI). Furthermore, more than 40% are from abroad. Our experiences so far are that key traits for successful recruitments are:

1. Shared value and committed to work within the research framework of SRC (which is clearly spelled out in the previous Action Plan (2007-2013), and also repeated and elaborated in this Action Plan (2014-2018).
2. Compatible with the collaborative working mode, including necessary social skills.
3. Strong academic track record and creativity.
4. Openness for interaction with knowledge systems beyond academia, including policy and practice.

8.6 The Venue

The SRC is located at the Kräftriket campus of Stockholm University, and from 2014 all staff will be placed in the same building, because SEI moved to other premises in the end of 2013. A new campus of Stockholm University – Albano –, situated across the highway from the present venue, is planned to be built. Parts of the SRC's urban research have been deeply involved in the planning of the new campus, to be top-of-line regarding social-ecological urban planning and physical design, including ecological corridors etc. The Centre will be offered a new attractive venue there (see the Progress Report 2007-2012) when built, perhaps in 2019. The conditions for interdisciplinary research will be better as we will be able to design the localities in an optimal way for our needs, including "caves and commons" to support a good mix of opportunities for individual concentration and interactions with others.

8.7 Strategic collaboration with other organisations

SRC has a large number of national and international collaboration, as presented in the Progress Report 2007-2012. Close partners are naturally the founding organisations Beijer and SEI, and departments at Stockholm University. The Beijer is, compared to SRC, a much smaller organization and it is deeply integrated with the SRC. Units of research, communication and administration of the two organizations collaborate on a daily basis. Therefore, it is impossible to distinguish between SRC and Beijer efforts and achievements. The plan is to even further develop this cooperation. The other founding partner, SEI, is a larger organization than SRC – including several regional offices worldwide. SEI and SRC have several areas of cooperation, with several of SEI research staff involved in common research endeavours with colleagues at SRC. SRC and SEI also cooperate on policy/practice activities, as for example during the 2011 3rd Nobel Laureate Symposium on Global Sustainability in Stockholm. Although SEI has, from 2014,

stepped out of the consortium and has moved to other localities, the cooperation with SEI will continue. The more long-term consequences remains to reveal.

Cooperations with other departments or centres at Stockholm University are relatively well developed. SRC is a core partner in two major research programs that involve several partners within the Science Faculty, namely Ekoklim and BEAM:

- Ekoklim – A multiscale, cross-disciplinary approach to the study of climate change on natural resources, ecosystem services and biodiversity. See www.zoologi.su.se/ekoklim.
- BEAM – Baltic Ecosystem Adaptive Management. See www.smf.su.se/beam.

At Stockholm University, SRC also has well-developed collaboration with research groups or individuals at the following departments:

- Economics
- Economic History
- Law
- Political Science
- Education
- Human Geography
- History
- Physical Geography and Quaternary Geology
- Applied Environmental Science
- Ecology, Environment and Plant Sciences

As indicated in the Progress Report, in the daily work at SRC we are involved in collaboration with many research organizations and individuals all over the globe. SRC's strategy is to seek collaborations with scientifically excellent scholars wherever they are located. Even more important than the location is the shared interest, values and cooperative working mode.

In the next phase SRC will further explore the possibilities establish or deepen strategic partnership on research and education with a carefully selected organizations of differ categories:

1. Universities in the Stockholm-Uppsala region.
2. Organizations worldwide that complement SRC in competence, for mutually beneficial cooperation. Organizations in e.g. China and Japan would be important complements to the present network.
3. Organizations worldwide with similar focus and working mode (often placed-based research on ecosystem stewardship), including the Resilience Alliance Network, the Natural Capital Project at Stanford University etc.

8.8 Fundraising – core funding beyond Mistra

In 2013 the SRC's financial turnover was somewhat more than SEK 100 million. Of this, about 30% can be labelled "core funds". This implies funds that are long-term and not earmarked to specific projects. Core funds are thus largely uncommitted funds that can be allocated for long-term strategic purposes. Most of these funds are used for permanent research positions, some for within and cross theme activities, workshops, communication etc. They can, in the future also be used for educational purposes (e.g., a flexible fund for PhD and Post-Doc positions).

The Mistra funds constitute about half of SRC's core funds (about 15 % of the turnover) and Stockholm University contributes with almost the same share. To fulfil its mission the Centre needs to balance short-term external funding for specific project, with long-term strategic core funding. Due to the prevailing research funding system, small and short-term research grants is relatively easy to obtain, whereas long-term and relatively free funds are rare. This bias towards short-term funding may eventually imply diversion of the Centre's research into too many and separated directions and short-term employments. This may in turn threaten the Centre's long-term ability to define emerging research areas, and its comparative advantage of interdisciplinary cooperation, which requires critical mass of long-term funding.

Our assessment is that the Centre's long-term core funding should amount to at least 40 % of the total turnover, and under no circumstances fall below the current 30 %, in order to allow the Centre to operate at the frontier of sustainability science. This implies two strategic funding challenges for SRC: (1) to increase the annual core funding from the present level, and (2) to replace the Mistra funding when it ends after 2018. If not successful in replacing the Mistra funding and if the balance of core funding goes far below 30 %, the entire endeavour of SRC is threatened.

There are two main paths to take in addressing this challenge. One is to justify and succeed in receiving an increase in core funding from Stockholm University. Compared with the University's core funding for research to other departments, the funding to SRC is low – given size and research achievements. Therefore, it seems plausible that SRC with time should be able to obtain more core funds from Stockholm University. But this is at present an open question. The other main path for increasing the core funding is to attract it from external sources, as for example major philanthropic donations or long-term funding from other foundations.

The SRC and the Beijer has already attracted some smaller and middle sized philanthropic donations, and the Centre has now decided to make a major effort of attracting more and larger such funds. In 2012 we therefore employed a fundraising specialist, who is working part time on developing SRC's fundraising strategy and abilities, closely together with the leadership. A first step has been to set up an "SRC International Advisory Board" (IAB), which so far has five distinguished members from business and is chaired by Hans Enocson, CEO of GE Nordic. The IAB will help the Centre to identify exclusive long-term partnerships with individuals or organisations that share our vision and that are interested in being strategic partners in our mission.

9. Funding

9.1 Summarizing the challenges and opportunities

The Stockholm Resilience Centre faces three funding challenges over the coming five years. The first is to raise the core funding level from current 30 % to 40 % of the overall Centre budget, which is a strategy to enable emergence and the ability to stay at the frontier of sustainability science and contribute effectively to advance inter-disciplinary approaches to social-ecological systems research, contribute to integrated capacity development and be effective in bridging science to policy and practice. The second is to continue the prudent and effective use of approved Mistra funding 2014-2018, and thereafter seek a replacement of the Mistra core funding (currently 18,6 MSEK/yr). The third challenge is to grasp the opportunity of raising further SRCs capabilities, relevance and impact to a new level, in order to match the growing demand for resilience based sustainability thinking in the world. This third ambition, which is concretised as the overall achievement of this Action plan, will require, we assess, raising our overall strategic long-term core funding with another 20 MSEK/yr.

Our overall funding strategy, translating our 2018 goals as outlined in this Action plan, of a world leading research centre, closely connected to a global network of scientific nodes and playing an international convening role and leader in teaching and training, will thus require the following: (1) sustaining a base-level of funding at an average level of 107 MSEK/yr, enabled by a gradual growth of external funding from the current 38 MSEK/yr to an estimated 50 MSEK/yr in 2018, (2) an overall increase in the share of core funding to project funding from the current 30 % to 40 %, in order to align the SRC with the core funding level expected for cutting edge science departments with a large PhD program and a significant commitment to education, and (3) a new investment growth reaching approximately 20 MSEK/yr by 2018. This will result, overall, in a Centre in 2018 with a total budget of approximately 130 MSEK/yr.

9.2 The SRC financial situation

As described in this Action Plan, the SRC makes the overall assessment that (i) it is still in a formative and evolutionary phase expecting a gradual growth over the coming five years even under a "status-quo" funding scenario, and (ii) that the SRC has an opportunity and responsibility to continue expanding its role as an international science centre in sustainability science, which in turn will require a step-change in funding for certain key investments.

The SRC had in 2013 an annual budget of 107 MSEK, of which approximately 30 MSEK per year (about 30 %) constitutes core funding, divided on Mistra funding of 17 MSEK per year plus around 13 MSEK per year from Stockholm University (SU) (core funding excluding all education, both MSc and PhD and funds for temporary undertakings as postdocs etc.). The 13 MSEK per year of core funding from the SU is an early estimate for 2013 onwards. It is based on a number of decisions and assumptions in connection to the transfer of SRC into the Science Faculty. In addition SRC will receive an extra income from the faculty for PhD dissertations, estimated to 1,4 MSEK in 2013.

Addressing the three funding challenges

1. Raising SRC's core funding level

Raising SRC's core-funding level from current 30 % to at least 40 % of the overall Centre turnover, as argued in chapter 8 above, will require an increase in long-term flexible funding. This is a necessary step in order to enable SRC's long-term ability to formulate and carry out cutting edge research, to leverage external strategic grants with matching funds. Our experience is that the more strategic the external research funds are, the more likely they are to require matching funds, which means that core-funds are of fundamental importance. They also provide the ability to leverage external research funding, which means that one unit of core funds can result in 2-3 times higher total research funding. Core funds, importantly also enable investing in advancing

inter-disciplinary research and education (which tends to be more costly, due to higher degree of dialogues, integration and bridging in thinking compared to disciplinary research). Our strategy to achieve this is through new core-funding, from for example foundations or philanthropic grants, generated by the already initiated fundraising function of SRC.

2. *Mistra support 2014-2018 followed by replacement of this strategic core funding.*

The basic task to ensure the envisioned core grant support from Mistra for the second regular phase (2014-2018) has been achieved. SRC needs to address the challenge of gradually replacing the Mistra core funding, after 2018, when the second regular phase ends. This is a very large challenge, given the difficulty in generating long-term core funding. SRC will have to pursue a multitude of avenues to secure its core funding level in the future, ranging from dialogues with Stockholm University, foundations and “un-conventional” sources of funding from philanthropy etc. The newly activated fundraising function, including the IAB, of the SRC is one strategy to act on this challenge and additional funding from the university is a complementary option we will investigate (see also chapter 8).

3. *Investing in raising SRC to a higher level of achievement and delivery.*

Our ambition is to grasp the opportunity of raising further SRC’s capabilities, relevance and impact to a new level, in order to match the growing demand for resilience based sustainability thinking in the world. The aim is to expand existing, and develop new, ideas or aspirations of SRC undertakings. Such aspirations are listed in the summary-table in chapter 1, some of them are further developed in this Action Plan (e.g. in chapter 5), and a concrete suggestion of five selected modules of expansion is given in this chapter – summarized in Table 9.1.

These strategic modules of expansion are estimated to require additional funding of totally 20 MESK per year when fully developed (see Table 9.1). This constitutes our assessment of the investment needed to take SRC to the next level as an international convener and knowledge provider of sustainability science, and in bridging science to policy and practice. A significant part of this proposed investment constitutes strategic core-funding; the proposed 6 MSEK for permanent research positions and a flexible fund for PhD and postdoc positions (4 MSEK per year).

We here present possible modules for further expansion of the SRC already from 2014, based on the assessment of SRC’s performance and potential in the future. The five possible modules presented in Table 9.1 are all considered strategic by SRC and the suggested extra input of funds is tentatively distributed and could be allocated differently, according to preferences from possible donors.

Table 9.1. Possible modules for increase in core funding (20 MSEK per year).

Modules	MSEK
New long-term research positions	6
Platform for global research synthesis	3
Platform for policy-practice dialogues	3
New PhD and postdoc position	4
Develop global PECS network	4
Total	20

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