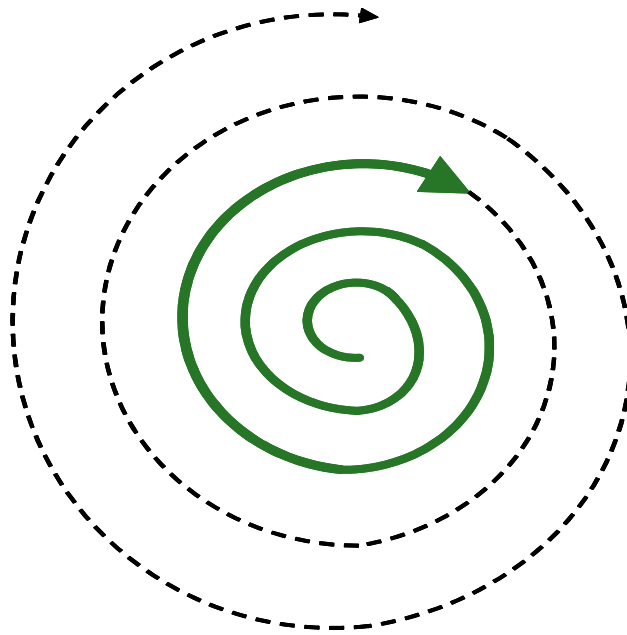


Strategic Leadership towards Sustainability



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Published at *Blekinge Institute of Technology*, Karlskrona, Sweden, in close cooperation with *The Natural Step*

Core Curriculum for the Master's Programme
"Strategic Leadership towards Sustainability"

About the Book and the Cover

This book follows a whole-systems, structured approach to the concept of strategic leadership towards sustainability. It is based on systems thinking, and revolves around a five level framework for planning and decision-making in complex systems - Backcasting from Principles. From a thorough enough understanding of the (i) system, in this case, human society within the biosphere, follows a (ii) principle understanding of success, in this case sustainability, which allows for a (iii) systematic planning methodology that informs (iv) actions as well as the (v) tools for monitoring and managing the actions.

The spirals on the cover symbolise the way these materials are presented – beginning with a high level, structured overview of core concepts (the innermost circle) followed by progressively more detailed and sophisticated consideration of concepts in later circles (while always taking advantage of the clarity offered by the structured approach). The introduction to this book addresses the ‘first circle.’ Part 1 (Chapters 1 – 4) covers ‘Circle 2’ and Part 2 (Chapters 5 – 13) goes into more detail, collectively covering Circle 3. The outer circles (4 – 5) represent later, more advanced aspects of the overall Master's Programme (for which this book is intended). Circle 4 is course-based whereas Circle 5 is based on a final thesis where a particular topic will be explored in depth.

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Contents

Acknowledgement / ix

To the Reader / xi

Introduction to Strategic Leadership Towards Sustainability / xiii

PART 1. An Overview of the Method Backcasting from Principles to Inform and Guide the Practice of Strategic Leadership Towards Sustainability / 1

- Chapter 1. Moving from the Cylinder Paradigm to the Reality of the Funnel / 3**
 Introduction / 4
 The Cylinder Illusion versus the Reality of the Funnel / 6
 Some Experiences from Organisations that Recognize the Funnel / 11
- Chapter 2. Planning in Complex Systems – Backcasting from Basic Principles for Success / 15**
 Introduction to Decision-Making in Complex Systems / 16
 A Generic, Five Level Model for Planning in Complex Systems / 28
 The Five Level Model for Sustainable Development / 30
 The ABCD Process: A Game for Sustainable Development / 45
- Chapter 3. Getting Professional – the Role of Experience / 49**
 Starting the Sustainability Game / 50
 Using Experience to Determine Priorities at the Detailed Level / 53
 Conclusion / 58
- Chapter 4. Implementation – Alignment of Practices, Tools and Concepts / 61**
 Introduction / 62
 A Brief Description of some Tools, and their Relationship to the Framework. / 63
 Some Related Organisational Initiatives and Concepts / 70
 Conclusion / 77

PART 2. A Deeper Look into Some Related Disciplines / 83

- Chapter 5. Basic Science and Ecological Sustainability / 85**
Introduction / 85
Scientific methods / 87
Ethics / 88
Science, Natural Laws and Principles / 88
Thermodynamics / 94
Complex Systems/ 118
History of the Earth and the Evolution of Life / 126
Basic Principles for Ecological Sustainability / 134
- Chapter 6. Social Sustainability / 141**
Introduction / 142
The Social Template – Strategic Planning for Social Sustainability / 148
- Chapter 7. Our Economy and the Governance of Our Commons / 165**
Introduction / 166
Public Policy and Macroeconomics (Within “Society in the Biosphere”) / 170
Discussion / 188
- Chapter 8. Organisational Learning and Change / 199**
Introduction / 200
A structured Guide to Organisational Learning and Change / 203
Conclusion / 218
- Chapter 9. Management Systems for Sustainable Businesses / 219**
Introduction / 220
Management Systems / 223
Building the Vision / 225
Business Planning from the Vision / 228
Managing the Strategic Plan / 244
- Chapter 10. Systems Thinking and Modelling for Sustainability / 255**
Introduction / 256
What is Systems Thinking and Modelling? / 257
Discussion / 276

Chapter 11.	Industrial Ecology / 281
	Introduction to Industrial Ecology / 282
	Sub-Concepts of Industrial Ecology and the Five Level Model for Strategic Planning / 286
	Concluding Remarks on Industrial Ecology and Strategic Planning for Sustainability / 299
Chapter 12.	Sustainable Product Development / 301
	Introduction / 301
	Product Development / 302
	Ecodesign versus Sustainable Product Development / 306
	A Method for Sustainable Product Development (MSPD) / 309
	The Sustainable Design Space – A Proposed Integration / 312
	Conclusion / 315
Chapter 13.	The Science and Subtleties of Backcasting from Basic Principles of Sustainability / 317
	Part 1: Questions and Answers about the framework / 318
	Part 2: Questions and Answers about the <i>Application</i> of the framework / 331
	<i>Glossary / 341</i>
	<i>Key References / 347</i>

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To the Reader

About the Masters Programme

The Masters programme named *Strategic Leadership Towards Sustainability* is offered at the Blekinge Institute of Technology (*Blekinge Tekniska Högskola*) in Karlskrona, Sweden.

This Masters programme builds on four central themes:

- (1) four scientific principles for socio-ecological sustainability;
- (2) a planning methodology of "backcasting" based on those scientific principles for sustainability;
- (3) a five-level model for planning in complex systems, into which backcasting is incorporated as a strategy; and
- (4) the understanding that within basic scientific constraints, creativity is allowed and encouraged.

This course book focuses mainly on the description of a structured approach to sustainable development and is the primary reference for the Master's programme within this scope. The text revolves around a generic, structured model for planning and decision-making in *any* complex system, recognizing that the key focus for sustainability, human society within the biosphere, is inherently a complex system. As such, the text describes five essential system levels including: (i) the system; (ii) success; (iii) strategy; (iv) actions and (v) tools. Within this 5-level model, the approach "backcasting from principles of socio-ecological sustainability" provides a solid basis for *strategic* sustainable development.

With respect to the second theme, the textbook emphasises that the basic constraints required by the structured approach (the 5-level model, backcasting, and scientific principles of sustainability) actually serve to promote creativity in ways that are productive and complementary to the goal of sustainability. Chapters 6-13, in particular, explore how this approach spurs innovation toward sustainable development in a number of selected disciplines (e.g. organisational learning, strategic business planning, industrial ecology, product development).

Course Book Chapter Layout

The introduction chapter presents all the core elements of the planning methodology named Backcasting from Basic Socio-Ecological Principles of Sustainability. Part 1, of the book, containing the first four chapters, covers the next circle and goes deeper into the core elements without losing the overall structure. Part 2, containing the following nine chapters, takes a third, yet deeper, look at some related disciplines like basic science, social sustainability, organisational learning and change, industrial ecology, etc. (Circle 3). The whole idea of Backcasting from Principles is to create a meaningful structure of the overview, and only then tackle the details on a higher and higher degree of detail.

Relationship with Other Programme Materials

This course book is part of a *set* of written materials for the *Strategic Leadership Towards Sustainability* Masters Programme that include:

1. **Course Book** with the core learning materials most closely related to the core curriculum for the Masters Programme, *Strategic Leadership Towards Sustainability*. This book covers circles 1, 2 and 3 of this programme.
2. **Supplementary Materials**, some of which will be provided to the students as an overall set, include programme explanation and course outlines, class schedules, select articles, guidelines on oral presentations, written reports, facilitation techniques, natural cycles and global trends, aspects of human needs and satisfiers, organisational and personal learning supplements, etc. Materials will be added throughout the programme (these documents will relate to primarily to circles 3 and 4).
3. **General Publications List**. A publications list will be made available to help students with more detailed exploration into specific topics of study and research (these documents will relate also relate primarily to circles 3 and 4).

Introduction to Strategic Leadership Towards Sustainability

I think that there are good reasons to suggest that the modern age, the industrial era has ended. Today many things indicate that we are going through a transitional period, when something is on the way out and something else is painfully being born. It is as if something is crumbling, decaying and exhausting itself while something else still indistinct, is arising from the rubble.

Vaclav Havel

OVERVIEW

Havel's wise observations are synonymous with the current search by many scientists, policy makers and society-at-large for some emerging, post-industrial age. However, it is not yet clear how this something else will painfully be born. In particular, pursuing an attractive and ecologically and socially sustainable society is a highly complex undertaking. What will be required? We will need a clear understanding of social, ecological and institutional reality – both now and over the very long term. Because we are dealing with complex systems, this demands a broad, systems view. We will also need an inspired, energetic approach to change – one that arises out of purpose, learning and meaning. On both fronts, an intellectual framework anchored in science and empirical evidence has much to offer.

A Challenge for Scientists and Policy Makers

In order to move towards sustainability, society needs a constructive dialogue on sustainability issues between scientists on the one hand, and decision-makers in politics and business on the other. This opinion may seem simple to justify, yet applying it in practice is controversial. The scientific community has many reasons to retain a detached and specialised attitude as regards engaging in public political discourse. Because scientific progress is exploratory in nature, there is often a sense that the scientific community does not, or cannot, agree on anything. Additionally, in many cases the science behind sustainability is nascent. Combined, these factors can create a challenging context for constructive dialogue.

Political arguments often utilise scientific data to underpin various points of view. All too often, this occurs in biased ways, aimed at 'proving' pre-set objectives, value systems and ideologies. Contemporary proponents of nuclear energy for instance tend to focus on its carbon neutrality only, implying that this technology constitutes an appealing, long-term solution that will reduce global CO₂ emissions. However, this fails to

acknowledge the fact that nuclear energy is derived from a finite resource (i.e. uranium ore) and its use includes severe radiation-related risks and side-effects that span geological time scales. Knowledge supporting the respective ideologies in such instances is selected and highlighted, and contradictory knowledge is disregarded or given relatively lower weight. This is contradictory to the goals of scientific exploration. In this way science is often taken hostage in the marketing of ideologies or contrasting viewpoints rather than actually serving rational decision-making. This creates additional tension between the scientific community and policy makers.

For the scientist, scientific data – particularly in natural sciences – are often not researched and collected for normative reasons, but with a goal of a neutral search for knowledge. Furthermore, increasingly specialised fields of natural science have evolved over time – from a few natural sciences such as chemistry, physics and biology, to a great number of subdivisions of those sciences, including many more applied fields of science. At the same time, there have been a growing number of social sciences due to increasing subdivisions or new combinations within fields such as sociology, anthropology and economics. This has created an increasingly complex landscape for both scientists and other decision makers in society.

Decision-making must build on information from these many specialised fields. However, trans-disciplinary science has not kept pace with the development within the specialist sciences. As a consequence, the ability to assess, synthesize and communicate conclusions from the ever increasing sets of trans-disciplinary data has not kept pace with the needs of decision making. Current attempts to study trans-disciplinary areas to inform policy decisions are often less robust when compared with today's level of rigor obtained by more specialized studies. Thus, although critical for policy making today, the attempts often appear to be inadequate or insubstantial. As a result, policy-making has suffered – often resulting in debates about short-term trade-offs between various sub-optimal choices – rather than articulating a comprehensive and strategic way forward.

Knowledge for Scientists and Decision-Makers		
	Scientists	Decision-Makers
Focus	Specialized fields of study (nanotechnology, pharmacology, bioethics, plant chemistry, etc.)	Policy issues that encompass multiple fields of study (genetic modification)
Reason for information gathering	Search for knowledge and understanding (e.g. how can we modify wheat to carry vaccines?)	Support for political ideology (should we allow "pharming"—genetically modified plants to carry medicine—in our nation?)
Result	Need for more rigorous transdisciplinary studies and better communication with policy-makers!	

Table i.1. Summary of approaches to knowledge of scientists and decision-makers, respectively

One key concept that scientists and decision-makers must understand is that relevant societal decisions and policy-making *cannot be directly arrived at from scientific knowledge alone* – such attempts are called ‘the naturalistic fallacy’.¹ Quite the opposite, all decisions, even with scientific data taken into account, are filtered through our social value system.

Science cannot tell us that we *should* plan for sustainability; that is, after all, a value-based judgement. However, once an agreement is made that we *want* to plan for sustainability then science has a lot to say about the *conditions* for sustainability. For example, science can provide insight into sustainable and non-sustainable flows of matter between societies and ecosystems, help evaluate various technologies to solve such problems within the constraints given by the conditions, and offer descriptions of the efficiency of various measures to induce social change and acceptance of new technologies and cultural mindsets.

¹ The naturalistic fallacy is committed by those who mistakenly think that the term "good" and the property "goodness" can be analysed in terms of some other property. The naturalistic fallacy tries to draw a conclusion about how things *ought to be* based solely on information about how things *are in fact*. The conclusion may be about moral duties or about ideal states of affairs; but the unstated (and false) premise is that we must always accept things as they are. An example might be: "According to the Darwinian theory of evolution, the most adapted and powerful creatures will survive. Therefore we shouldn't make special efforts to feed the poor. If they can't survive on their own, that just means they aren't as capable or well adapted as we are."

The Role of Systems Science in Informing Sustainability and Public Policy

The fact that science cannot unilaterally inform policy-making is in no way an excuse for the scientific community to abrogate its responsibilities as regards informing the nature of societal policies. A more helpful approach would be to seek knowledge to support decision making by applying two qualitative guidelines, phrased here as questions:

- *What kind of knowledge do decision-makers need?*
- *How should it be structured to best serve decision-making?*

Without a good understanding of how to structure knowledge, we often seek wisdom but, instead, drown in information. One solution to this problem is to identify underlying principles upon which existing data can be structured for the sake of comprehension. We need such principles:

- to evaluate what type of information we need to come to a decision
- to evaluate what type of information we do *not* need for a decision
- to discover when available data is not sufficient for making decisions

Through structuring of information, the scientific community *can* support informed decisions and policy-making without compromising either the integrity of individual fields of science or the scientist's own individual values.

Context of this Book

Starting in the 1940's, scientists developed "systems theory", a transdisciplinary study of the abstract organisation of phenomena, independent of their substance, type, spatial or temporal scale of existence. Systems theory investigates both the principles common to all complex entities, and the (usually mathematical) models which can be used to describe them. The theory emphasises that real systems are open to, and interact with, their environments, and that they must be studied in a holistic manner, rather than in through reductionist methods. In summary, systems theory promotes the view that "the whole is greater than the sum of its parts".

This textbook focuses on a subset of systems theory—the study of complex systems. In general, the more complex a system is, the less accurate predictions of behaviour can be. In the case of the system called "society in the biosphere", the complexity is so great as to be virtually impossible to predict with any certainty. To confront this challenge, we present, "Planning and Decision-Making in Complex Systems through Backcasting from

Basic Principles," a methodology developed via scientific consensus and pioneered by the international non-governmental organisation, The Natural Step, and its network of scientists. By learning and applying this structured approach to decision-making, students are equipped to strategically approach the challenges of an unsustainable world.

BACKGROUND

Society continues to repeat the same mistakes. The problematic industrial history of many materials, products and services reveals two points that should be kept in mind for planning:

- Sometimes impacts occur through complex interactions in the biosphere that cannot be determined beforehand. At best, a certain impact can be clearly related to a certain activity or process only *after* it has occurred. Additionally, determining a specific impact is sometimes scientifically difficult, and the delay from the discovery of impacts to policy change may be too long to avoid severe damage.
- This *speaks in favour of discovering first-order principles by which practices can be evaluated and strategies determined upfront and upstream*, rather than after damage has already occurred downstream as second-order effects. Because many second-order impacts are not easily reversed, a strictly reactive approach is insufficient for sustainable development.

The Natural Step, an international non-governmental organisation (NGO), in collaboration with scientists internationally, has promoted and supported the development of a framework for sustainable development that takes these points into consideration and incorporates (i) backcasting² from (ii) basic principles for sustainability³:

(i) Backcasting is a planning procedure by which a successful planning outcome is imagined in the future, followed by the question: "what do we need to do today to reach the successful outcome?"

² Holmberg, J and Robèrt, K-H. 2000. "Backcasting from non-overlapping sustainability principles – a framework for strategic planning", *International Journal of Sustainable Development and World Ecology*, 7:1-18.

³ The first version of these sustainability principles were published in Robèrt, K-H. 1991. *Det nödvändiga steget* (The Necessary Step). Stockholm: Ekerlids Förlag.

(ii) The term Basic Principles for Sustainability denotes principles that are designed for backcasting from sustainability. They are:

- a) ... based on a *scientifically agreed upon view of the world*;
- b) ... *necessary* to achieve sustainability;
- c) ... *sufficient* to achieve sustainability;
- d) ... *general* to structure all societal activities relevant to sustainability;
- e) ... *concrete* to guide action and serve as directional aids in problem analysis and solutions, and
- f) ... *non-overlapping*, or mutually exclusive in order to enable comprehension and structured analysis of the issues.

Backcasting from Scenarios

The Backcasting from Basic Principles methodology has been elaborated from Backcasting from Scenarios – a planning methodology built on the envisioning of a simplified picture of success⁴.

"Backcasting from Scenarios" is a method for planning where a more or less specific picture guides the game and helps the player deal with its complexity—similar to a jigsaw puzzle. It is most useful when a relatively static picture of the future can be arrived at.

Backcasting from scenarios is helpful when dealing with emotionally-charged decisions. By asking decision-makers (and associated stakeholders) to envision a specific picture of the future, bias and value judgements are exposed and can be dealt with in an open manner. This method is also useful for helping business, especially financial institutions, ensure that they do not take on too much risk.

Although backcasting from scenarios is a methodology that may encourage people to be more strategic, creative and cooperative toward shared visions, it can also have associated disadvantages for sustainable development. For example:

- It can be difficult for large groups to agree on detailed descriptions of a successful sustainable outcome due to differences in values, backgrounds, etc.

⁴ Robinson, J.B. 1990. "Futures Under Glass – A Recipe for People Who Hate to Predict.", *Futures*, 22(8): 820-843.

- Technical development may change the conditions for planning, making the scenario irrelevant.
- Detailed scenarios of a sustainable enterprise may in fact prove unsustainable. For example: "Are photo-voltaics really sustainable – what do they contain and what is the ultimate resource potential for this technology?" If the answer is no then any detailed scenario relying on photo-voltaics is inherently flawed.

In this light, it is clear that more adaptive and open ended methods are needed to scrutinize any scenario with regard to its ecological resource potential and the complexity of its social and economic system dynamics.

Backcasting from Basic Principles

On the other hand, backcasting directly from basic principles of sustainability resembles *chess*, where the principles of success guide the game (i.e. the principles of checkmate in chess, or basic principles for sustainability in sustainable development). This is a dynamic planning method whereby each move takes the current situation of the game into account while at the same time optimizing the possibility of winning. In the case of chess, a large number of winning combinations (i.e., moves towards checkmate) exist. The end result of the method is that the number of potential ways to win remains large while the probability of selecting winning moves increases dramatically with each strategic move.

Rather than agreeing on detailed descriptions of a desirable distant future, it is easier to (i) agree on basic principles for success, (ii) agree on initial concrete steps that can serve as flexible stepping-stones in the right direction, and (iii) continuously re-evaluate transitions along the way.

If wanted, backcasting from principles can be combined with backcasting from scenarios. The scenarios are then scrutinized by the basic principles before being used for backcasting.

AN OVERVIEW OF THE FIVE LEVEL MODEL

For comprehensive planning in any complex system, it is valuable to delineate five hierarchically different system levels and to maintain the distinction between the levels in planning. These levels include: (i) the Systems level, (ii) the Success level, (iii) the Strategic level, (iv) the Action level and (v) the Tools level.

Watch Out! Renewable energy, for example, is often regarded as a principle for sustainability, belonging to the (ii) Success level, whereas it actually belongs to (iv) the Action level. Switching to renewable energy in the form of bio-fuels, for example, could lead to deforestation and is therefore not in itself a principle for sustainability. However, if sustainably managed, such renewable energy may comply with basic principles for sustainability.

The structured approach of this programme is based on these five levels as they relate to the complex system of "individual within organisation within society within the ecosphere".



Figure i.1. The five level hierarchy provides a structured understanding for planning and decision-making for success in any complex system.

At the heart of planning and cooperation is Level 2 – Success. It should inform strategies, actions and the design of our tools. Strategy (Level 3) is guided by backcasting from principles for success, i.e. by imagining that the conditions for success are complied with, and then proceeding by asking: "what shall we do now to optimize our chances of getting there?" and "then what?" (until conditions for success are met).

Level 1. The system – individuals, organisations, communities, nations, in society in the biosphere.

At the systems level, fundamental characteristics of society and its constituent organisations existing within the biosphere need to be understood. To assist our efforts, we explore the dynamic interrelationship within and between the ecological and social systems. These can be understood with the careful use of science including; thermodynamics and conservation laws, biogeochemical cycles, basic ecology, the primary production of photosynthesis. In the social realm, we can better understand the system by looking at social institutions, networks, characteristics of society's interdependent pursuit of human needs and the importance of diversity.

The systems view reveals an important reality of today's unsustainable society. The problem of unsustainability is not only that we have emitted a lot of pollutants causing some impacts. The problem is that industrial society is designed so that pollutants are bound to increase in concentrations globally. For example, emission of greenhouse gases has resulted in a certain amount of climate change but it follows from the laws of nature that as long as energy systems are organized as they are, atmospheric concentrations of greenhouse gases will continue to increase. At the same time, natural systems are systematically declining from destruction by physical means such as over-harvesting and growth of infrastructure. In short, waste is steadily accumulating and resources are steadily declining. Therefore, the resource-potential for society and the economy is systematically decreasing. At the same time, the Earth's population is increasing and the gaps between the haves and the have-nots are growing.

Unsustainable development can be visualized as society entering deeper and deeper into a funnel, in which the space for deciding on options is becoming narrower and narrower per capita. This reality contrasts sharply with a widely held illusion that we are in a 'cylinder' where isolated social and ecological impacts come and go in an *ad hoc* series of events, without creating large-scale or cumulative impacts.

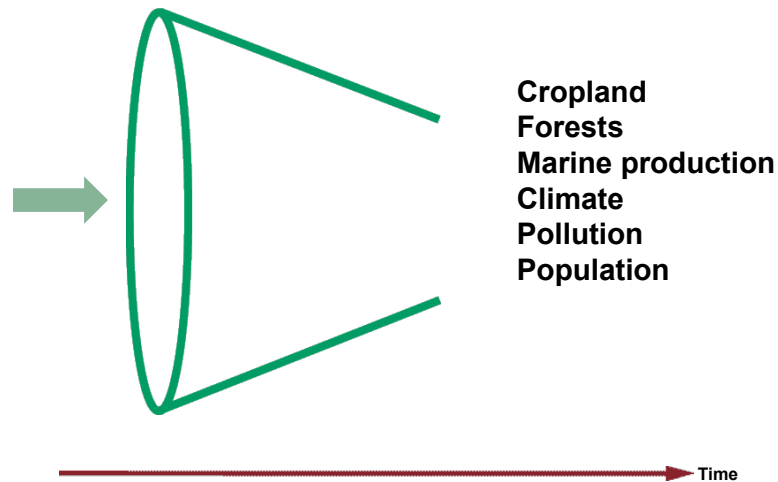


Figure i.2. The funnel metaphor shows the systematic decline in options for society and organisations within society.

To avoid "hitting the walls of the funnel" (i.e. avoiding increasing risks), organisations must stay on the cutting edge of solutions towards sustainability.⁵ Hitting the walls may appear as:

- i) increasing costs for resources, waste management, taxes, and insurance premiums;
- ii) increasingly strict legislation;
- iii) loss of good reputation;
- iv) over-corrections when concrete negative impacts surface;
- v) lost investments due to sub-optimized measures and blind alleys and
- vi) loss of market share to those who develop cutting-edge solutions.

A common argument against a proactive approach is that the timing for reacting to unsustainability is difficult to determine. The logic, however, should apply in reverse. If you knew that you were driving towards a cliff but you didn't know where the road ended, you would get off the road sooner rather than later! What we do today influences our chances tomorrow, and the sooner that society aligns its priorities with sustainability constraints, the better the chances for a successful future. The funnel is a metaphor that

⁵ Throughout this text book the term "organisation" refers not only to businesses and non-profits, but also to communities, governments, and individuals.

is applied to sensitise the businesses, communities and society-at-large to the larger picture and bring about enlightened self-interest.

Level 2. Success in the system – basic principles ("system conditions") for social and ecological sustainability.

At the success level, it is important to incorporate the basic element of strategic thinking – beginning with the "end in mind" and understanding successful principles (e.g. chess) rather than successful scenarios (e.g. jigsaw puzzle).

In order to arrive at a principle definition of success – in this case sustainability – we must know *enough* about the system (level 1) – in this case the biosphere, human societies and the interactions and flows of materials between the two. Since the concept of *sustainability (level 2)* becomes relevant only as we understand the un-sustainability inherent in the current activities of society, it is logical to design principles for sustainability as restrictions, i.e., principles that determine what human activities must *not* do in order to avoid destroying the system (level 1). CFCs were "harmless" yesterday, but which compounds are "harmless" today? Tomorrow? In what principle ways could we destroy the biosphere/society's ability to sustain us? These questions are answered by looking *upstream* in cause-effect chains, where basic errors of societal design trigger the thousands of negative impacts occurring downstream.

Re-design within basic constraints of sustainability is the only way of tackling our current problems sufficiently upstream, and thereby avoiding new problems looming in the future. At the principle level, complexity is at its lowest. The comprehension that follows from understanding this level makes it possible to ask the right questions and to structure all the details in a way that makes sense from a decision making point of view. With an added "not", such basic principles for destroying the system would be conditions for sustainability within the whole system (Biosphere and Society) – or "system conditions".

Basic Principles for Sustainability

The negative impacts related to unsustainability encountered today can – on the basic principle level – be divided into three separate mechanisms by which humans can destroy the biosphere and its ability to sustain society:

1. A systematic increase in concentration of matter that is net-introduced into the biosphere from outside sources (the lithosphere, or Earth's crust – i.e. mined materials);
2. A systematic increase in concentration of matter that is produced within the biosphere; and
3. A systematic degradation by physical means.

Sustainability of society, however, also depends on the maintenance and robust functioning of social systems – formal institutions as well as the informal structuring of civic society-at-large (the "social fabric"). Or, in other words, sustainability also requires that we not systematically undermine the social fabric. This requirement is not only necessary to sustain society itself, but also to comply with the first three ecological constraints in that if basic needs are not met, people do not have a short term option to adjust for the long term goals of sustainability. This requires a fourth basic constraint that takes social sustainability into account.



Figure i.3. Sustainable Society within the Biosphere. Society (inner circle) exists within the living system or biosphere (outer circle). Both of these systems interact with the earth's crust, or lithosphere (bottom of figure). Flows from the lithosphere to the biosphere include inorganic (e.g. minerals involved in photosynthesis) and directly to society (e.g. mined metals and fossil fuels). Physical resources also flow from the biosphere to society. Society distributes, uses and discharges these

various resources. Lithospheric, human-produced, and nature-based substances flow back to the biosphere as what is commonly called waste. The numbers in the figure refer to the part of the system governed by the basic principles for sustainability listed in the box below.

The four constraints constitute the *four basic principles for sustainability*⁶ and state;

In a sustainable society, nature is not subject to systematically increasing...

- I ...concentrations of substances extracted from the Earth's crust,
- II ...concentrations of substances produced by society,
- III ...degradation by physical means

and, in that society. . .

- IV...people are not subject to conditions that systematically undermine their capacity to meet their needs.

Implications of the Basic Sustainability Principles for Planning and Decision-making

1. *The societal influence on the biosphere due to accumulation of lithospheric material is covered by the first principle.* The balance of flows between the biosphere and the lithosphere must be such that *concentrations* of substances from the lithosphere (e.g. carbon as CO₂ from fossil fuels or metals such as Mercury and Cadmium) do not systematically increase in the whole biosphere, or in parts of it. Besides the upstream influence on this balance through the amounts of mining and choices of mined minerals – including the respective mineral's or metal's relative scarcity in normal ecosystems – the balance can be influenced by the quality of final deposits, and the societal competence to safeguard the flows through recycling and other measures. What concentration can be accepted in the long run depends on properties such as ecotoxicity, here taken in a broad sense to include effects on geophysical systems, and bioaccumulation.

Due to the complexity and delay mechanisms in the biosphere, it is often very difficult to foresee what concentration will lead to negative impacts. A general rule is not to allow

⁶ These are the basic principles for a sustainable society in the biosphere (or “basic sustainability principles”). They are widely known in the business community as The Natural Step “System Conditions”, named after the non-governmental organisation of the same name. In this book, we will widely use the phrase: “basic sustainability principles” or “sustainability principles.”

deviations from the natural state that are large in comparison to natural fluctuations. In particular, such deviations should *not be allowed to increase systematically*. Therefore, what must at *least* be achieved is a halt to systematic increases in concentration of matter that is net-introduced to the biosphere from the Earth's crust. Depending on the characteristics of the respective substances and the recipient, the critical concentrations differ (e.g. Aluminium and Iron are naturally plentiful in nature whereas Mercury and Cadmium are relatively scarce). This must be taken into account when we consider flows and develop monitoring schemes.

2. The societal influence on the biosphere due to accumulation of substances produced in society is covered by the second principle. This mechanism differs functionally from the first, since *production* refers to the combination of elements into compounds, whereas basic sustainability principle 1 reflects net-inputs of elements either as elements such as in metals, or embedded in compounds such as various kinds of minerals.

The flows of molecules and nuclides that leak out from societal activities must not be so large that they can neither be integrated into the natural cycles within the biosphere, nor be deposited safely into the lithosphere. The balance of flows must be such that concentrations of substances produced in society do not systematically increase in the whole biosphere or in parts of it. Besides the upstream influence on this balance through production volumes and characteristics of what is produced, such as degradability of the produced substances, the balance can also be influenced by the quality of final deposits, and competence to safeguard the flows through measures such as recycling and thermal treatment. As with metals, the complexity of qualitative differences amongst various compounds creates high demand for a subtle guidance as regards the respective flows and practices.

3. The societal influence on the biosphere by physical means is covered by the third principle. This mechanism covers the destructive manipulation, displacement and harvesting of natural capital⁷ and natural flows within the biosphere. This condition implies that the resource basis for (i) the productivity in the biosphere (such as fertile areas, thickness and quality of soils, and availability of fresh water) and (ii) biodiversity in the biosphere, is not systematically degraded by, for example, over-harvesting, mismanagement through monocultures or invasive species introductions, disruption of groundwater flows, or displacement such as asphaltting productive ecosystems. Again, the complexity is high, and we need a way of addressing this complexity that is simple enough yet still scientifically valid.

⁷ We will return to the concept of 'natural capital' in Chapters 4, 5 and 9 in particular.

4. *Social dynamics and the production of services for humans are covered by the fourth principle.* This mechanism addresses the challenge that conditions faced by society do not inhibit people's ability to meet their needs, over and above all the substitution and dematerialisation⁸ measures taken in meeting the first three objectives. The term "needs" is here not only defined as basic physical needs, such as food and fresh water, but all constitutional needs that that must be satisfied for humans to stay mentally and socially healthy as well – e.g., protection, affection, understanding and identity⁹.

Taken together, the first three basic sustainability principles define an ecological framework for any sustainable society. The fourth principle is the basic social condition, interacting with the other three in a dynamic way. If the purpose of society is to meet human needs worldwide now and in the future while conforming to the ecological constraints given by the first three principles, then the use of resources must be efficient enough to succeed. However, it will not be sufficient solely to strive for the dematerializations and substitutions needed to comply with the first three basic sustainability principles. Social sustainability implies that we also need improved means of dealing with issues of equity and fairness from the perspective of *human needs* and population growth. It is, for instance, an inefficient use of resources, from the perspective of humanity, if one billion people starve and lack access to safe drinking water, while at the same time another billion use valuable resources for low-value activities such as sitting in traffic jams. These issues could begin to be addressed by keeping the current and future basic needs of humanity in mind when decisions are made, and understanding the factors that contribute to people's ability to meet these needs.

Level 3. Strategy for success – guiding principles for the process to arrive at sustainability.

Logical and generic guidelines, built on backcasting, are available and inform a step-by-step approach to selecting flexible platforms, or logical stepping-stones, within an overall strategy. This needs to occur at the individual (e.g. dialogue, diplomacy and coaching), organisational (e.g. community building and institutional culture) and societal levels (e.g. incentives such as taxes, regulations, etc.).

⁸ Dematerialisations refer to using less of the same substances (i.e. mined resources, manufactured products, energy, nature-based resources, etc.). Substitutions refer to changing to new types of materials, flows and management routines etc.

⁹ Human needs and their relationship to social sustainability are addressed in more detail in Chapter 6.

Given that basic sustainability principles are for the whole biosphere, an organisation that wants to make strategic progress towards sustainability can start its planning by translating the basic sustainability principles into objectives or its own organisational sustainability principles that are relevant to it. Backcasting from these principles for success is like playing chess, where a strategic approach to winning (and every move, or action) is informed by understanding the principles for success, or in the case of chess, the principles for "checkmate").

For an organisation that does not want to be a problem in the system, a way to translate basic principles for a sustainable society in the biosphere would be to add "our contribution" to the phrasing of the basic principles:

The sustainability principles translated for an organisation are to:

1. ...eliminate our contribution to systematic increases in concentrations of substances from the Earth's crust.
2. ...eliminate our contribution to systematic increases in concentrations of substances produced by society.
3. ...eliminate our contribution to systematic physical degradation of nature.
4. ...eliminate our contribution to the systematic undermining of human's ability to meet their needs worldwide.

We will return to how this can be interpreted as specifics in practical life, but already we can see that this will mean for instance, to:

- ...substitute certain minerals that are scarce in nature with others that are more abundant, using all mined materials efficiently, and systematically reducing dependence on fossil fuels.
- ...substitute certain persistent and unnatural compounds with ones that are normally abundant or break down more easily in nature, and/or use all substances produced by society more efficiently through dematerialisation.
- ...draw resources only from well-managed eco-systems, systematically pursuing the most productive and efficient use both of those resources and land, and exercising caution in all kinds of modification of nature e.g. avoiding over-harvesting and introductions of exotic species.

- ...check whether our behaviour has consequences for people, now or in the future, which restrict their opportunities to lead a fulfilling life by asking whether we would like to be subjected to the conditions we create.

Backcasting Using The ABCD Strategic Process

Each individual organisation must draw its own conclusions from these basic principles as regards problems, solutions, goals and sub-goals. The four-step "ABCD" process below provides a systematic way of guiding this intellectual process:

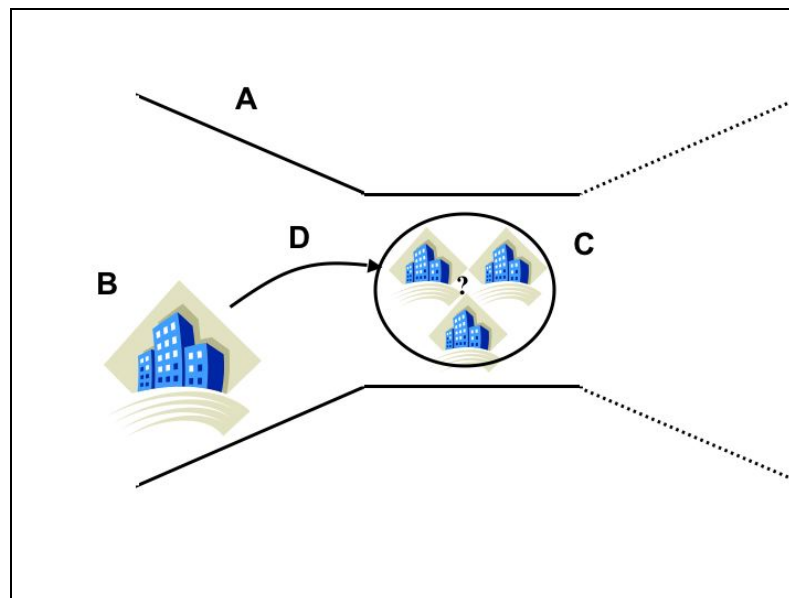


Figure i.4. The ABCD Process. A Strategic Tool for Backcasting from Basic Principles for Sustainability.

The ABCD Steps:

- (A) *Awareness:* The framework – including the system conditions, the step-by-step approach to comply with them, and an organisation's motivation for doing so in a strategic manner – is shared as a mental model for community building

xxx

amongst the planning participants (i.e., playing the game of Sustainable Development by the same rules);

- (B) *Baseline*: An assessment of "today" is conducted by listing all current flows and practices that are problematic from a sustainability perspective, as well as considering all the assets that are in place to deal with the problems; To assess 'now' from an imagined point of principle 'winning' in the future is an essential element of backcasting. This is how the chess player assesses and reassesses the situation after each move – in relation to the principles of check-mate.
- (C) *Visioning*. Solutions and visions for "tomorrow" (i.e., the opening of the funnel) are created and listed by applying the implied "constraints" of the sustainability principles to trigger creativity; and,
- (D) *Setting and Managing Priorities*. Priorities from the C-list are made, and action plans are created.

Priority Setting in D:

Suggestions from the C-list are prioritized (similar to when moves in chess are scrutinized for their potential as stepping stones to eventually reach checkmate) by searching for measures that respond "yes" to the following three questions:

- i. Does this measure proceed in the right direction with respect to all principles of sustainability?*
Sometimes a measure represents a trade-off that proceeds in the right direction with respect to one of the principles while working against others. Asking this question helps illuminate the full picture, and lead to complementary measures that may be needed to take all sustainability principles into account.
- ii. Does this measure provide a stepping-stone (i.e. 'flexible platform') for future improvements?* It is important that investments, particularly when they are large and tie-up resources for relatively long time periods, can be further elaborated or completed in line with the sustainability principles in order to avoid dead ends. An example would be investing heavily in a technology that will cause fewer impacts in nature today, but without the potential for adapting to contributing to complete compliance with the system conditions in the long run.
- iii. Is this measure likely to produce a sufficient return on investment to further catalyze the process?*
It is important that the process does not end due to lack of resources or bad investments along the way. Note that "investments" do not just refer to financial resources, but also to political, social, and cultural resources.

Measures that answer "yes" to all three questions provide the strategic element of the methodology. Each suggested idea or action (e.g. investment) is scrutinized for its potential to (i) move towards sustainability, (ii) serve as a flexible platform, and (iii) bring resources (e.g. financial, social, intellectual, etc) to further development.

Level 4. Concrete actions that fit strategic guidelines

Level 4 includes all concrete actions taken in the system. To better understand this level and importantly, how it relates to the other levels, it is helpful to look at a rich sampling of actual case studies from businesses and municipalities as well as examples from the transport, agriculture, forestry, and fishery sectors. For example, actions related to energy systems are useful to review in the areas of photo-voltaic, wind, wave, fossil fuels, and nuclear power. All actions are examined in the context of overall strategies (Level 3) to reach sustainability (Level 2) in the system (Level 1).

Level 5. Toolbox – various tools and concepts for sustainable development.

Various tools and concepts are available and should be examined for possible use, including a formalized and strict way of applying the TNS framework in itself – the "ABCD Strategic Tool" (see above). In addition, management systems (e.g. Environmental Management Systems such as ISO 14,001 and EMAS), assessment and monitoring programs for the current situation as well as on-going progress can be useful. A new approach to Life Cycle Assessment, based on a comprehensive sustainability view, holds particular promise¹⁰. Finally, complementary approaches for sustainable development, such as Factor 10, Zero Emission, Ecological Footprinting, Natural Capitalism and others can be examined in relation to the ultimate goal of sustainability.

PLAYING THE "SUSTAINABILITY GAME"

The five level model represents a structured comprehension for understanding sustainable development, *not* a sequential *process* leading from one level to the next. Instead, it is important to understand all levels and the connections between them *simultaneously*. One cannot say that one level (e.g. 2 – "success") is more important than the other (e.g. 4 – "actions"). To say this would be like suggesting that principles for

¹⁰ Ny H., Broman G., MacDonald JP., Yamamoto, R. and Robèrt, K.H. 2004, "Sustainability Constraints as System Boundaries: An approach to make Life Cycle Assessment Strategic", submitted to the *Journal of Industrial Ecology*.

xxxii

successful flight (level 2) are more important than construction of a structurally sound airplane (level 4). Developing one's own structured comprehension takes practice applying the five level model – playing the sustainability game.

The structured comprehension provided by the five-level model is designed to be a shared mental model for cooperation around sustainable development that is generic enough to be applied for any activity at any scale. To make that possible, we have utilized scientific thinking, methodologies and scrutiny to the best of our knowledge. *Applying* the framework, on the other hand, is where the art begins. It's about community building, genuine creativity, ethics, aesthetics, group dynamics, common sense and psychology. After all, it's only when musicians or chess players have mastered the basics that they can successfully improvise.

