Contents: Systemic Planning

By Steen Leleur, publisher POLYTEKNISK FORLAG, 2008

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… selection is the dynamic of complexity. Every complex system must adapt itself to time – in whatever operatively graspable form this requirement takes for the system.

Niklas Luhmann in “Social Systems”, 1984, p. 42

Preface

This book is about systemic planning. It treats this topic by taking a broad sweep from the rationales that can be found in the theoretical developments of the 20th century in systems science and the most recent complexity theories, to an outline of the qualifications and skills necessary for an envisioned systemic planner. Some relevant methodology is set out: a planning framework SCOPE and a multi-criteria method COSIMA.

As indicated in the title, the main concern of this book is with principles and methodology for planning in a complex world; I argue that there is a need for a wider, more systemic approach to planning. Getting to grips with the notion of "systemic" is therefore important in what follows. Right away, it should be noted that I will use the term systemic in a quite comprehensive way, i.e. as including both quantitative ("hard") and qualitative ("soft") issues relating to both concepts and methods. By referring to systemic planning, I want to define a conception of planning that includes both its more conventional meaning – as a kind of special case – and new ideas that relate to issues of societal complexity which necessitate a renewal of thinking about planning.

Planning quite basically assumes that proactive effort is worthwhile. We find planning behaviour both on a small scale – a person preparing a trip abroad for example – and on a larger scale, where organisations, be they public or private, try to prepare and manage future action in accordance with what they find “best” under the given circumstances. While the maps for a travelling route abroad in most cases may be reliable information, the “maps” offered to both public and private organisations and enterprises into the “future-scape” are much less reliable. We live in a complex world. Accordingly, this world is not always easily comprehended in a way that would allow our preparations for future-oriented action to be rational in accordance with some chosen standard. What then is the role of planning? How do we get support for future-oriented decision-making? These and other questions reside within a fundamental and more wide-ranging one: what becomes of the meaning of planning when unpredictability and complexity seem to characterise the planning task ahead of us? Possible and hopefully plausible answers to this question are set out in this book.

The topic is seen as both important and timely. Our Western type of society is transforming from modern via postmodern to what we may preliminarily term the hypermodern society. Such transformation heavily impacts our organisations and the professionals who work in them. A general trend underlying these changes is the greater uncertainty and complexity that condition the processes of change everywhere. In fact, I will later characterise the hypermodern society now beginning to unfold in the 21^{st} century as characterised by hypercomplexity. So later on, I call the new type of society the hypercomplex society. The question to be dealt with therefore concerns whether planning can be a meaningful endeavour in the organisations of the hypercomplex society. The book is written out of the conviction that there is a positive – but cautious – answer to be given.

In Chapter 1, the foundations of systemic planning are laid out as we identify and seek to get to grips with three different types of complexity: detail complexity, dynamic complexity and what is called preference complexity. This leads to a clarification of some of the ideas that constitute systemic thinking and influence the development of systemic planning. The chapter also introduces two paradigms relating to simplicity and complexity thinking, and it ends with some planning-related definitions that give the basic ideas of systemic planning.

Chapter 2 examines what are presented as the three waves of systems science. By reviewing the work of the major systems researchers of the 20^{th} century, we obtain insights that can assist in ramifying and enriching the foundations of systemic planning laid down in the first chapter. This makes it possible to formulate the contents of a systems-based research approach to planning. I conclude the chapter by comparing various research approaches that can be used in current thinking about planning theory and practice, including the one actually treated in this book, which stems from a complexity theory orientation.

In Chapter 3, a communication-based planning model is developed by making use of the theories set out by the German sociologist Jürgen Habermas. This model makes it possible to focus on a wider concept of rationality in the planning process and thereby reorient our attention with regard to the content of an appropriate planning practice. The model makes it clear why traditional, so-called rational, comprehensive planning (or analytical planning) is insufficient – and sometimes even misleading – in complex settings, and what issues we need to focus on to reconsider it. On this basis we take a closer look at learning and causality, both of which thanks to specific theoretical developments, are found to contain insights that can prove helpful in renewing planning. Finally, an outline of a new systemic type of planning is presented.

The final Chapter 4 presents the contours of the hypercomplex society seen as the upfront challenge demanding a renewal of planning. One basic recognition is that societal types shift to make it possible to cope with ever increasing complexity. Applying the German sociologist Niklas Luhmann's theories, attention is given to the concepts of contingency and functionally differentiated societal systems. On this basis, the theme of planning, politics and power is actualised. Finally, the qualifications of the systemic planner are listed as a kind of summary of selected findings; together they serve as suggested guidance on systemic planning.

An Epilogue about systems science and complexity seeks to compare the current development trends in systems science by focusing on some main characteristics. It concludes that there is some potential in applying complexity theory, but adds the qualification: if not yet as a science then at least as a sort of wide-ranging awareness.

In two appendices some methodological exemplification is given. Specifically, this concerns SCOPE, which is a framework for planning in complex settings, and COSIMA, which is a kind of multi-criteria methodology that, because of its flexibility, is seen as useful in a multi-methodology approach.

It should be noted that the two appendices have been written so that they can be read independently of the main text. This leads, however, to a few minor overlaps with the main text but typically with the more lengthy arguments omitted. The advantage is that the appendices hereby offer an opportunity for the more practically-oriented reader to approach the examples and ideas of systemic planning more directly; hopefully in this respect they can also serve as an entrance to the more elaborate views developed throughout the book.

With the purpose of providing further information on systemic planning, a website has been established with relevant download material, links, etc.: www.systemicplanning.dk

It is my hope that this book can serve as a balanced, yet reasonably precise introduction to systemic planning and that every reader will find inspiration to pursue and develop the ideas and suggestions within his or her own area of profession and interests.

Virum, October 2004
Steen Leleur

ADDENDUM TO THE SECOND EDITION

The main text of the book has been supplemented with some update information about the practice and methodology of systemic planning. Furthermore, Appendix 2 about COSIMA has been rewritten and an Appendix 3 has been added about proposals for future development.

Virum, May 2008
Steen Leleur

Acknowledgements

The finishing of this book is a good occasion to thank people that have been helpful in various ways. First I would like to thank professor C.J. Khisty, Illinois Institute of Technology (IIT), for many years of collaboration about issues in transport planning and systems theory. This has, among other things, led to a number of co-taught courses, both in Chicago and in Copenhagen, and co-authored papers and articles, and our collaboration has been a great inspiration. My thanks also include Alex Schmid, managing director of Savannah Simulations in Switzerland, for making available his rare combination of skills, mathematical modelling in consultancy and a university background in philosophy, for the betterment of this book. Next my thanks go to colleagues at the Technical University of Denmark (DTU). Especially I would like to mention associate professor Sten Bonke, associate professor Morten Elle and associate professor Per Galle. Since its conception in the mid-1990s our common Ph.D. course about planning, design and management has served as a valuable test-bed for several of the ideas on planning renewal and their treatment in this book. Further thanks go to all the students for their interest in planning related topics. Here I will also include coming classes in the DTU Ph.D. course 13235 about "Advanced Planning Theory". With the book as one of the course texts, I foresee that their contributions will be a valuable basis for a future update of the text.

Appendices 1 and 2 about SCOPE and COSIMA were written as updated versions of papers that were presented at the 4th EUROSIM Congress in Delft 2001 (COSIMA) and at the EURO/INFORMS Joint

International Meeting in Istanbul 2003 (SCOPE). The latter paper in an edited version in print is to appear in *Innovation*, Vol. 17, No. 3, 2004. I wish to thank TUDelft and Taylor & Francis © for permission to make use of the material in this book.

Finally but not least my thanks go to my wife, Susanne Leleur, for her never failing support and patience while I have been working on the manuscript for a book that would "soon be finished". Due to my continued interest in the topic and concurrent new developments in planning and complexity theory, it probably never will.

S.L.

ADDENDUM TO SECOND EDITION

Many people deserve thanks for their valuable feedback on the first edition of *Systemic Planning* (SP). Thus the students in the Planning Theory course classes at DTU in 2005, 2006 and 2007 ought to be mentioned for valuable comments and their application of SP, as ought the audiences from my presentations of various SP issues at the following conferences: The IFORS Triennial World Congress on Operations Research and Management Science (OR/MS), Honolulu, July 2005, the 11th ANZSYS – Managing the Complex V Conference, Christchurch, December 2005, The United Kingdom System Society (UKSS) 11th International Conference, Oxford, September 2006, The Korean Development Institute and World Bank (KDI & WB) Conference on Large-Scale Public Infrastructure Management, Seoul, May 2007, and the International Society of Systems Sciences (ISSS) Annual Meeting, Tokyo, August 2007.

Appendices 2 and 3 were written as updated versions of an invited paper to the above-mentioned KDI & WB conference and of a recent article in the international journal *Systems Research and Behavioral Science*, Vol. 25, No. 1, 2008. My thanks go to KDI and Wiley © for permission to make use of the material in this new edition.

On a personal level I would like to thank Director Bruce McKenzie, Systemic Development Institute, Vincentia, Australia and Dr. Louis Klein, Director of Systemic Excellence Group, Berlin. Both have provided very valuable comments. Also thanks to Lawrence White,

English Support, for kind assistance and to my Ph.D. students Michael Bruhn Barfod, Anders Vestergaard Jensen, Sara Lise Jeppesen and Kim Bang Salling who work in different directions of the SP framework. Their work is a great inspiration. Last but not least my thanks go to my wife Susanne Leleur for her continued support and patience. Needless to say: the book is still not finished ...

S.L.

1. Systemic thinking, complexity and planning

This book presents what I call a systemic view of planning. The ideas of systemic planning have been developed by reconsidering the premises of conventional planning in the light of current societal transformation, in which complexity and uncertainty play ever more dominant roles. One particular view treated is the way these factors condition and influence organisations and their professional staff in preparing and taking decisions about longer-term issues.

In this book not-so-new themes from the developments in systems science, which originated in the 1930s with its first formulation by the biologist Ludwig von Bertalanffy and with major developments during and after the Second World War by mathematicians such as Warren Weaver, John von Neumann and Norbert Wiener, and economists like Oscar Morgenstern and Kenneth Boulding, are reconsidered and put into context with the findings of more recent systems researchers and practitioners such as Peter Checkland, Michael C. Jackson and Gerald Midgley. Several other contributors from various professional fields – philosophy, social science and engineering to mention some of these – are called upon to depict the contents of systemic thinking and its potential for renewing planning under the new conditions that I will later describe as the hypercomplex society.

The nature of thinking in general

The undertaking of the book necessitates some reflections about thinking in general. Precise definitions are not necessary, but we do need to pin down some main points of relevance. In good agreement with our Western tradition we certainly want decision-making to be rational, which in our modern world means that our mental processing of a particular problem – our "inferencing" of it – must be logical and based on facts that are or can be scientifically validated. There should be general agreement on this orientation, as we do not want to embark on issues that are contradictory to such premises, even if fortune-telling and oracles seem to have played important roles in supporting decision-making. For readers interested in these aspects combined with a fascinating historical introduction to the development of modern probability theory and statistics, the highly entertaining presentation of Peter Bernstein (1996) can be recommended.

There is no doubt that the particular problem in hand influences the decision-making. The different professions addressed in this book, i.e. engineers, economists, etc., have a common characteristic because their respective education and training make them skilled and prepared to deal with the set of standard problems of their particular profession. Characteristic of problem-solving in wider problem-solving contexts, however, is a recurring mismatch between the expertise required and the expertise brought to the fore by the professional. This is not new in any way and is often addressed with an attitude like "real learning starts after university", and so on. One can certainly agree with the notion that learning is lifelong and that it evidently should be so; needless to say, our experiences affect us and crystallise as general experience that we can draw upon both in our professional spheres and elsewhere. The purpose of this book is to demonstrate that what I call systemic awareness and thinking can be a worthwhile effort for the professional to get to grips with and make use of in combination with his or her particular professional expertise and skills.

Back in the 1940s Susanne Langer (1969) published a book about "philosophy in a new key", in which she argued that the framework we make use of in our thinking – in her case the reflection upon various philosophical questions – impacts upon our answers to many questions. Paraphrasing her, the background of this book grows out of seeing a need for “planning in a new key”, in which this new key stems from applying the revolution brought about in systems science on planning as support of managerial strategic decision-making. Specifically, a new complexity thinking framework that interrelates with this revolution makes it relevant to explore its consequences for professional planning and decision-making. But how do we see that revolution and what makes it relevant at all to speak about a revolution also in the nature of thinking? – As stated already, I see decision-making as influenced by the factual problems. This almost trivial observation can serve as a point of departure for taking a closer look at various large-scale problem categories that were aggregated and classified in a mind-opening way more than fifty years ago. For this, we turn to the article by Warren Weaver (1948) in the journal *American Scientist* about “Science and Complexity”. This article is considered by many systems theorists as one of the seminal works in systems science and the forerunner of what nowadays has developed into complexity theory, emergence theory, etc.

Classifying complexity

Known as a statistician and as a scientific advisor to the American government since the 1930s, Warren Weaver (1948) set out to find a pattern in scientific inquiry as it had taken place both in the most recent centuries and in the most recent decades. As concerns the latter, the early formulations in the 1930s – with for instance the basic systems concepts of summative and non-summative characteristics as found in biological systems and elsewhere, see von Bertalanffy (1973) – were very soon followed by other theoretical developments: the formulation of utility- and game theory by von Neumann & Morgenstern (1944), the generalisation of control theory into what Norbert Wiener described as “cybernetics” (1948), and the communication theory of Shannon (1948). A general set of methods including linear programming by George

Dantzig et al., became collectively known as operations research and had their origin in the efforts to optimise military strategy and resource allocation during the Second World War (Gass, 1969). Among the recent research developments at the time of his writing, Weaver also included fields such as molecular genetics and computer science, while his retrospect on the last couple of centuries concentrated on major developments in physics; here the Newtonian laws, due to the development of statistics and probability theory, had given rise to statistical mechanics and modern relativity and quantum theories. Seeking a pattern in these developments, Weaver formulated three broad categories of scientific inquiry (Johnson, 2001, pp. 46-47):

- Simple systems involving two or three variable problems: rotation of planets, the connection between an electric current and its voltage and resistance, etc.
- Huge systems involving millions or billions of variables: molecules of gases, patterns of heredity, etc.
- Moderate systems involving a number of variables between the simple system and the huge system, but with the characteristic that the number of variables is not the primary characteristic.

Considering the huge system as compared to the simple system, Weaver described it as characterised by "disorganized complexity", whereas addressing the intermediary moderate system he found a type of complexity not dependent upon the number of variables. He reasoned that the complexity of this category of scientific inquiry was primarily due to interrelations. In his own formulation (Weaver, 1948, p. 540):

> The really important characteristic of the problems of this middle region … lies in the fact that these problems, as contrasted with the disorganized situations with which statistics can cope, show the essential feature of *organization*. In fact, one can refer to this group of problems as those of *organized complexity*.

The concept of organised complexity has been of major importance for the development of systems science. In a now also famous article by the economist Kenneth Boulding (1956) about the “Skeleton of Science”, this skeleton was depicted as made up of lower level entities in a hierarchy (see Table 1.1) successively fed into higher levels, thereby giving a rising order of different types of scientific investigation.

Table 1.1

Boulding’s hierarchy of systems: Altogether nine levels of systems with increasing complexity are identified.[1]

Level	Description	Characteristic	Example
9.	Transcendental systems	Beyond our knowledge	Religion
8.	Socio-cultural systems	Roles, values, communication	Family, community, society
7.	Humans	Self-consciousness, knowledge, language	Human beings
6.	Animals	Nervous system, self-awareness	Birds and beasts
5.	Genetic systems	Society of cells	Plants
4.	Open systems	Structurally self-maintaining	Cells
3.	Control	Closed-loop control	Thermostats
2.	Clockworks	Predetermined motion	Solar system, clocks, machines
1.	Structures	Static, spatial frameworks	Atom, crystal, bridge

We see that altogether Boulding identifies nine levels, in which the lower levels are the main concern of natural scientists, the middle levels of life scientists, while the upper levels relate to social science and the humanities. One characteristic feature as we move up the levels is that of emergence: new attributes arise and encapsulate previous ones[2]. One low-level example is water, where hydrogen and oxygen taken individually have none of the qualities of water, while a high-level example would be the capacity that human beings have for abstract thinking and making use of language that distinguishes us from our ape ancestors. Emergence is one of the really fascinating phenomena in systems science and the works of John Holland from the now world famous Santa Fe Institute (SFI) in New Mexico deserve special mention. From his years-long research based on computer-based life games (cellular automata) Holland found, among other things, that complex behaviour need not have complex roots (Holland, 1998, pp. 136-142). In his words: "Indeed, tremendously interesting and beguilingly complex behavior can emerge from collections of extremely simple components" (Waldrop, 1992, p. 279).

With planning and decision-making related to people and organisations – levels 7 and 8 in Table 1.1 – and the concept of organised complexity previously introduced, we have established *a first and very general platform* for further exploration. In this respect, special emphasis is given to the treatment of complexity. As the economist Herbert Simon (1968) and (1969) expounded, it can be argued that "rationality is bounded", which led Khisty & Leleur (1993) – working with uncertainty in human organisations represented as socio-technical systems – to state as another principal finding that "uncertainty is unbounded"; so it may not always be possible to eliminate uncertainty. The interesting feature with this finding is not so much that practical studies never have the data they need due to budget constraints and lack of available professional expertise, but that certain issues are complex for reasons of a more conceptual nature. In the presentation of the ideas behind systemic thinking and planning in this book, it is maintained that at least *three types of complexity* need to be taken into account in planning and managerial strategic decision-making. These are:

1. Detail complexity

2. Dynamic complexity

3. Preference complexity

These three types play a major role in the way we proceed to formulate the principles of systemic thinking. As we work towards the initial operational definitions of systemic planning at the end of the chapter, we can already state that we are dealing with levels seven and eight in Boulding's hierarchy, i.e. human beings and socio-cultural systems, and that our arena of examination is the socio-technical system. Here in a given context – to be expanded upon over the pages of the book – systemic thinking is a promising and possible way of confronting and dealing with those three types of complexity as they prevail in specific planning situations. Each type of complexity will be treated below to assess its meaning.

Detail complexity

If we want to demarcate our socio-technical system, we need a certain precision about the system we are dealing with. To introduce the concept of detail complexity, we may assume for the sake of symbolic illustration that one of the attributes we need is the length of some system element. As engineering students learn in a physics course about measurement theory, we can determine the length of a rod by making use of still better measurement equipment. Similarly, for its weight (or any other attribute) we can refine our approach by adopting a better technique. We try to remove uncertainty simply by getting more precise data. However, if we refer to the work of Benoit Mandelbrot and Helge von Koch, see Gleick (1987), and take a fractal view, we can never determine the length of a coastline, for example. In Figure 1.1 this has been exemplified by the

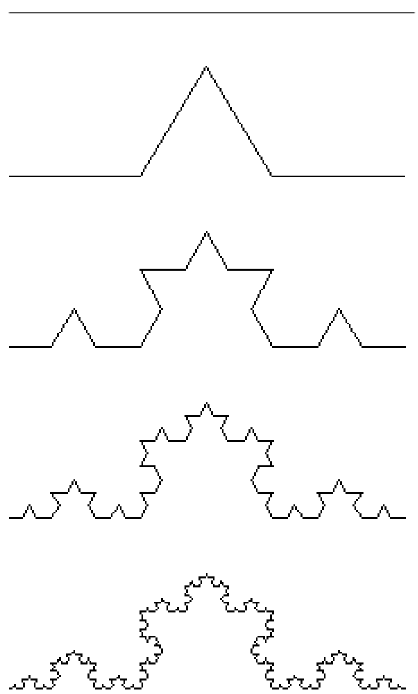

Figure 1.1 The Koch curve as a fractal resulting from an endless process of iteration. The Koch curve is made by starting with a side of length 1 and then adding a triangle with sides equal to one-third and so on. The length goes towards infinity.

graph known as the Koch curve (Buchanan, 2001, p. 48), which can be seen as a “rough but vigorous model of a coastline” in Mandelbrot’s words (Gleick, 1987, p. 99).

Detail complexity helps us focus on the influences from the system demarcations and the system components as they enter at an early stage in our examinations and/or models. Seemingly, the system is something that is given at the beginning of a study. This view, however, is much too simple because, beneath its mere representation, the system is also the result of a history that has “frozen into” the concrete system elements and their interrelations. To demarcate the system properly, we need to become aware of the details and their possible meaning and influence. This kind of awareness is made explicit to us through the work of physicists on complex systems. One important finding is that so-called critical states are ubiquitous. In socio-technical systems the occurrence of critical states is often what makes problems “wicked” (this type of problem is described in more detail later on). The need to pay attention to the details is well argued in the quotation below from Mark Buchanan, a theoretical physicist now working as a science writer (Buchanan, 2001, p. 16):

> By studying the natural kinds of patterns that evolve in networks of interacting things under non-equilibrium conditions, we may be able to understand an immense range of natural phenomena, from our turbulent atmosphere to the human brain. The study of complex systems is all about things that are out of equilibrium, and on this task, of course, scientists are really just starting out. So the relationship between the critical state and complexity is really quite simple: *the ubiquity of the critical state may well be considered the first really solid discovery of complexity theory.*
>
> And yet there is another useful way to look at all this. In coming to consider complex systems, physicists seem to have gained a new appreciation of a simple fact: in the immediate world around us, *history* is important. For living things, which ultimately develop from a single cell, this is obvious. But one cannot even understand the hardness of a steel pipe, or the irregular surface of a fractured brick, without referring to the full history of its making.

There is no doubt that system demarcation or boundary setting becomes problematic when the presumably “deep information” contained in the various system elements may or should impact on it, but at the same time it is of the utmost importance. Clearly the ubiquity of critical states makes it even more important. Thus there is no right way of doing the system demarcation, e.g. of “fixing” the dimension of detail complexity; the boundary-setting is a matter of choice and boundaries are partial as described by the well-known systems researcher Robert Flood (1999, pp. 64-65, underlining added):

> Defining an action area from the problem context through sweep-in and unfolding, centres on drawing boundaries around possible clients, and consequently surfacing issues and dilemmas relating to those clients for discussion. Boundary setting is an issue of great importance to systemic thinking. Put succinctly, the questions are, ‘Who is embraced by the action area and thus benefits? Who is out and does not benefit? What are the possible consequences of this? And, how might we feel about that?’ Boundary setting thus raises questions of ethics, efficiency and effectiveness, in a search for improvement and shows them to be inextricably linked. Boundaries are always open to further debate through sweep-in and are thus temporary. Boundaries are the result of choice. For each choice located by unfolding, there are always other possible options that will arise by sweeping in. Boundaries are therefore partial. The temporary and partial nature of boundary setting is suggestive of improvements to make, for now, but raises the question of how improvement is to be secured.

For these reasons I see boundary-setting as a major study influence and the way it should be dealt with as a major influence on my ideas about systemic thinking. At this stage of my presentation, it suffices to say that the demarcation of the socio-technical system that we are examining is by its nature “less given” than first impressions might suggest.

The medium in which detail complexity operates is typically “space” (covering resources such as persons and their skills, physical facilities, financial resources, etc., which make up the variables in this space). Clearly with many variables – and with each variable possibly having many attributes of relevance and with interdependence between variables – the detail complexity becomes full-fledged. Briefly stated, detail complexity relates to concerns about “means”.

Dynamic complexity

If we look at the theories in Peter Senge's *The Fifth Discipline* from 1990, we find that Senge operates with a complexity notion that involves both temporal aspects (complexity associated with "dynamics") and detail complexity consisting of a large number of variables being relevant but difficult if not impossible to combine and process at the same time. To the surprise of some, Senge and his collaborators give less attention to detail complexity than to dynamic complexity (Flood, 1999, pp. 13-14).

In Figure 1.2 the importance of dynamic complexity is illustrated by comparing the development of two weather patterns. With nearly the same starting point, the two patterns diverge over time and end up with no resemblance at all, see Gleick (1987, p. 17). The work of Edward Lorenz in the 1960s was very important in initiating research on chaos in dynamical systems, although deterministic chaos as a phenomenon had been known for many years due to the work of, among others, the French mathematician Henri Poincaré around 1900. The use of computers has come to play a major role in the research that started with the findings of Lorenz.

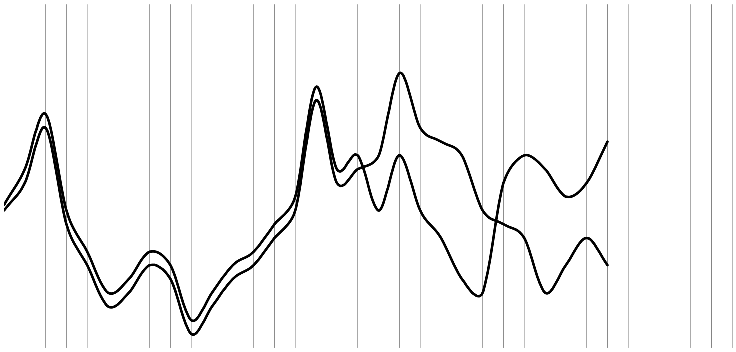

Figure 1.2 Weather sequences in a computer model: The Butterfly Effect by Lorenz. In 1961 the meteorologist Edward Lorenz found that small differences in starting conditions could mean a considerable change in end result. Thus a storm at one location may be seen as initiated by a butterfly flapping its wings and causing a small disturbance up-stream of the weather pattern propagation that resulted in the storm.

With the focus on planning and decision-making, we have to interpret the importance of dynamic complexity as making long-term forecasting for instance a highly doubtful undertaking. But many further insights are implied when we examine complex dynamic interrelations – not least if our focus is more on human organisations and their development than on weather pattern propagation. Perhaps in this context we should refer not to a Butterfly Effect[3] but to a Paperclips Effect or a rumour released one afternoon at the coffee machine. The organisations and chaos researcher, Ralph Stacey, has given the following interesting interpretation of organisational time dynamics (speaking in the context of the phenomenon of "change") by making reference to the so-called leverage points introduced into systems vocabulary by Peter Senge (Stacey, 1993a, p. 110). With a focus on studying business units as complex, dynamic systems Stacey says:

> The study of complex, dynamic systems provides the insight that the behaviour of a system cannot be understood simply by examining the system's parts. The system in effect has a life of its own. The system itself has a major impact on behaviour and therefore on outcomes. Thinking therefore has to proceed in terms of whole systems, their interconnections, and the patterns of behaviour they may generate. Changes accumulate slowly out of the interconnections between a system's parts. Focusing on snapshots of the parts, looking for cause-and-effect links that are close together in time and space, means missing the slow accumulation of change. Instead of trying to understand quantitative detail of parts, therefore it is far more fruitful to try to understand the qualitative nature of interconnections and patterns of behaviour. It is especially helpful to try to find the points in the system that are most sensitive and amplifying – the points of greatest leverage. By operating at these points rather than trying to control details everywhere, managers can bring about the greatest changes in the system with the least effort.

Peter Senge and his collaborators have managed to identify a number of what he calls "archetypes of change", which are dynamic organisational patterns. One of these is the “Tragedy of the Commons”, which occurs when two systems operate in the same environment and are rewarded initially by exploiting the environment (Jackson, 2000). The tragedy of the commons was originally coined by Garrett Hardin (1968) in an article in the journal *Science*, in which he examined individual actions and their cumulative consequences which, in an unwitting way, could be systematically destructive for the socio-economic unit made up of the individual actors. His picture was the medieval English village where each householder made the apparently reasonable decision to graze as many cattle on the commons as possible with the result that the commons would suffer overgrazing, leaving each and every householder in a poorer condition.

There is no doubt that a number of archetypes – Peter Senge operates with around a dozen – communicate what we would like to see as collectively gained lessons that are of importance with regard to interpreting possible development patterns. Clearly, they play a major role for the manager who does not want to embark on some kind of course that may later turn out to be less desirable for some reason. I don’t, however, think that downplaying the checking of details is generally to be recommended, see the quotation above, or that a relatively limited number of archetypes can possibly unfold a larger part of the dynamic complexity relating to change in business units, or – locating our system in Boulding’s seventh and eighth level, see Table 1.1 – to change in socio-technical systems in general.

The medium in which dynamic complexity operates is “time”. Stated briefly dynamic complexity relates to concerns about “path”.

Preference complexity

The ideas about systemic planning set out in this book consider a three-fold set of complexities which are of major importance for understanding and improving future-oriented decision-making. One major influence on these ideas – in addition to Herbert Simon via his writings about organisational decision-making (1968) and the sciences of the artificial

(1969), the first major exposition of the meaning and consequences of applying the view of organised complexity on organisations as systems – has been the German sociologist and philosopher Jürgen Habermas (1979, 1986, 1989). The following quotation brings the third type of complexity to the fore, namely what in this presentation is termed the complexity of “interests” (following the German term) or simply preference complexity (McCarthy, 1981, p. 328):

> ... a precondition of rational consensus is the thematisation of available need interpretations themselves; interests are neither empirically found nor simply posited – they are shaped and discovered in processes of communication.

What Habermas is saying here is that preferences (“interests”) are tied up with processes of communication and are therefore quite dependent on the issues raised and debated. To deal with the complexity involved and get to grips with the interests that might be associated with the various stakeholders, we need to understand the processes of communication. Later on in the book, I will confront Shannon’s theory of communication with the version stemming from Habermas. The two theories of communication are completely different. Making use of the complexity notions I have introduced, we might say that Shannon’s theory deals with a measurement of message transmission (with the complexity issues involved then relating more to the notion of detail complexity), whereas Habermas’s theory examines the basic components of human language and interaction (based on what he calls validity claims), and gives valuable insights that can support the inclusion of preference complexity in our view of systemic thinking.

The notion of preference complexity can be illustrated as follows in Figure 1.3 (Buchanan, 2001, p. 73):

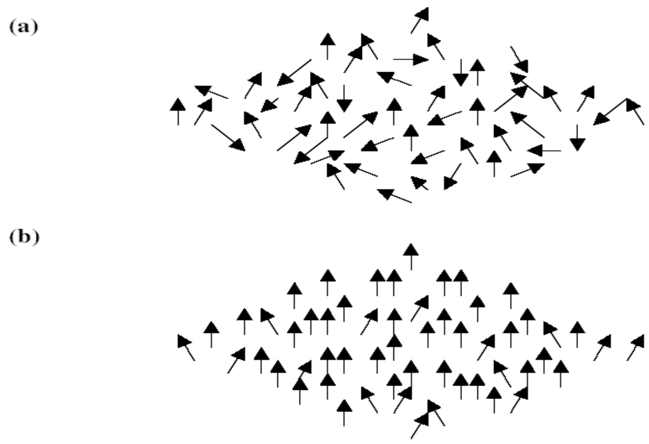

Figure 1.3 The shaping of an interest, symbolically illustrated by magnets in a piece of iron. At high temperature (a) atomic magnets in a piece of iron cannot organise in a co-ordinated way, whereas this becomes possible in (b) at a lower temperature, when the iron functions as a magnet. The arrows are here used to illustrate discordance and concordance in a certain type of preference.

The figure illustrates – in a very symbolic way only – the complexity involved when shaping and defining an interest. In part (a) we have all possible fragments and influences which in part (b) have obtained a certain degree of common orientation. What the figure really shows is atomic magnets in a piece of iron: at high temperatures (a) they cannot line themselves up due to thermal jostling, but at lower temperatures (b) they are able to organise with the result that the iron becomes magnetic. For our purpose here I will make use of the figure only in a symbolic way. So let us see the figure as showing a "heated debate" that may (or may not!) be cooling off and lead to clarification and explication of a certain interest, depicted symbolically as a change from (a) to (b).

Preference complexity – and the set of related issues to be addressed – has not had its proper role in the development of concepts and tools in systems science. This may be due to the main professions involved in its development over the five-six decades since the Second World War, with scientists, engineers and economists dominating and contributing on the basis of the terms and premises of their educational background.

The medium of preference complexity is “mind”. Briefly stated, preference complexity relates to concerns about “ends”.

In this way we have obtained complexities that operate in space (detail complexity), in time (dynamic complexity), and in mind (preference complexity). Later on – after dealing with the basic theories behind the complexities – we will be able to see that planning complexity relates to all three concerns: “means”, “path” and “ends”. In a situation where the planner is confronted with complexity in all three dimensions, I will refer to the decision situation as being “hypercomplex”. One theme of this book is that planners in the future will need to operate in a society which for many reasons can be described as hypercomplex; therefore hypercomplex planning situations may become less rare in the future than in today’s professional environment in which the professional acts as a planner, or more generally as a manager, or maybe as decision-maker in some other way.

Another theme of the book is the attention decision-makers in general will have to pay to complexity issues. I agree with Senge in believing in the importance of dynamic complexity, but pay at least as much attention to detail complexity. I will also pay considerable attention to preference complexity, because I have come to believe that insights into this type of complexity have a special role to play for any exposition of systemic planning and its role in improving future decision-making. The theories and methods that are presented and discussed are related to all three types of complexity.

In the following sections, I will first deal with some general classifications of problems facing planners and decision-makers, and then I will address the major concerns of systems science and systems thinking. This will enable us to wrap up this chapter with an outline of the basic ideas of systemic planning.

Categories of problems

So far, planning problems of managerial, professional concern have been addressed as one common category. With three dimensions of complexity and what I call hypercomplex problem situations less rare in the future, closer attention needs to be paid to the actual types or categories of problems. However, there is no doubt that many problems in the future will remain "accessible" and suitable for a conventional planning approach. The challenge then may be to identify the situations where such an approach will not work and therefore will need to be replaced by the suggested systemic approach. Examination of some of the typologies – or categories – of problems will therefore help to indicate which particular issues will become of relevance in a planning approach that aims at dealing with uncertainty and complexity in an explicit way.

We may consider as a first relevant categorisation of problems the means-ends configuration shown in Table 1.2, adapted from Khisty & Mohammadi (2001, p. 22).

Table 1.2

Problem types relating to the configuration of means and ends.

Problem types	Four different configurations and related approaches	
Means/Ends	Certain	Uncertain
Certain	A: Computation	C: Compromise
Uncertain	B: Judgement	D: Chaos or "Inspiration"

In the A situation, where we have certainty about both means and ends, our problem type is one of computation. Input can be stated and by using a proper algorithm we are able to obtain a solution to our problem. A very simple example here is a journey from one location to another: we can use car, bus or train or some combination, and we know the time when we want to arrive. By consulting a travel schedule website, for example, we can obtain a selection of the best travel schedules, maybe including modal shifts, and we can decide which possibility is the most attractive from the calculated number of minutes for each alternative and its cost. We can even take comfort issues, etc. into account and obtain a best solution in accordance with our trade-offs between time, costs and other issues we handle in an implicit way.

As soon as uncertainty characterises either means or ends, things start to get complicated: our choice may incline towards the car because we know that the public transport means, bus and train, operate only with some certainty in the peak hours for example. Or we may be in a situation where we are a little bit uncertain about our end point because, for example, we may want our recreational trip to take us to a place where fishing is good – and if not, we want to be able to continue to another location and so on.

On a scale we may see A as a "tame problem", whereas B and C represent stages towards the D situation, which I will characterise as a "wicked problem". In this book we will be concerned with all four situations, but the applicability of a systemic approach to planning and decision-making is first and foremost relevant with situations "on the way to being a wicked problem" or one which already "is a wicked problem", characterised by situations B, C and D respectively. The term "wicked" for characterising a certain category of problems stems from an article in the journal *Policy Sciences* in 1973. Here the authors, Rittel & Webber, characterise a wicked problem in the following way (Rittel & Webber, 1973, pp. 155-169):

- There is no definitive formulation of a wicked problem
- Wicked problems have no stopping rule
- Solutions to wicked problems are not true-or-false, but good-or-bad
- There is no immediate and no ultimate test of a solution to a wicked problem

- Every solution to a wicked problem is a “one-shot operation”; because there is no opportunity to learn by trial-and-error, every attempt counts significantly

- Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan

- Every wicked problem is essentially unique

- Every wicked problem can be considered to be a symptom of another problem

As can be seen, the really wicked problem goes well beyond our travel schedule example above. In such problem situations, our notions of rationality and certainty are really challenged. A major issue then is whether principles and methods can be formulated that are relevant to apply in such cases.

Another useful problem categorisation has been formulated by Stacey. It is about defining what he calls closed change, contained change, and open-ended change (Stacey, 1993a):

- Closed change: The key features of closed change are unambiguous problems, opportunities and issues, clear connections between cause and effect, and the possibility of accurately forecasting the consequences of change. Faced with such change, people tend to behave in easily understandable ways. The decision-maker can make use of rational decision-making techniques, and the processes of control are formal, analytical and quantitative. There is a clear purpose with clear preferences and alternative ways of achieving the purpose are known.

- Contained change: The key features of contained change derive from those change situations where it is possible to make probabilistic forecasts based on actions taken now and their most likely consequences. This is made possible because the consequences appear to some degree as repetitions of what has happened in the past or they relate to large numbers of essentially the same event. As a manager looks into the future, accurately predictable closed change declines in relative importance, while less reliably predictable contained change increases in relative importance.

- Open-ended change: Control in open-ended situations in practice means something completely different from what it means in closed and contained situations. In such situations, the future consequences are unknown and forecasting is totally impossible due to an ambiguous purpose or equivocal preferences of the actors involved. The whole situation being confronted is ill structured and accompanied by inadequate information, more or less subjective, and conditioned by personal ambitions, beliefs and values. There are problems with interpreting data and applying statistical techniques in uniquely uncertain conditions, for which reason forecasting and simulation become problematic. In open-ended change situations we do not know the consequences of what we are doing until we have done it.

The latter statement about not knowing the consequences in advance of actions to be taken is really one of Stacey's strong points. His considerations have led him to speak about the "unknowable". His viewpoint is expressed in the quotation below (Stacey, 1993b, p. 7):

> Everyone admits that the future is basically unknowable, particularly in the case of an innovative product or course of action. This prospect, however, makes many managers uncomfortable, and they then ease their discomfort by assuming that even innovative futures are nonetheless approximately knowable. One can at least, they say, have a vision or make some assumptions about the long-term future. One can give shareholders, or others in a controlling position, meaningful information on future rates of return and risk levels.
>
> I argue that this is a soothing fantasy that distracts attention from, and weakens the resolve to deal with, the real world. Instead of

> sidestepping the issue of unknowability, managers must learn to face it head on. That means accepting that you really have no idea what the long-term future holds for your organization; forming visions and making assumptions are not realistic possibilities. It means accepting that no individual or small group can be in control of an organization's long-term future …

One can agree with many of Stacey's findings in his comprehensive writings about organisations and issues relating to change (Stacey, 1993a, 1993b, 2000). However, I cannot agree with his very principal meta-finding above that one should recognise and accept that no individual or small group can be in control of an organisation's long-term future. On the contrary, the viewpoint argued in what follows is that proactive effort – seen as planning in its broadest terms – is worthwhile; it is necessary for the consequences of action to be scrutinised in advance of any concrete action. As a professional endeavour, this is the job of planners and managers.

Two different kinds of problem categorisations have been illustrated. So far, they have served to demonstrate that issues arise in modern organisations that are wicked or messy in a way that means that at least a conventional planning approach may be the wrong management tool. The problem categorisations will be used later on to exemplify what a more general approach to planning – the systemic planning approach, which sees the conventional approach as a special case under certain conditions of a reasonably "safe" type – can offer, given messy conditions.

Having touched upon various categories of complexities and problems, the following sections introduce what "systemic" really means and why systemic thinking is seen to have a potential for improving planning and decision-making under certain conditions. We will approach this topic by first getting to grips with some of the more general ideas that have been developed in systems science.

What is systems science?

So far, I have remained a little bit vague about the notion of “systemic”, not to mention the concept “system” from which systemic is derived. The word “system” derives from the Greek words “syn” and “histemi”, which literally means setting something together. So when we talk about a system, we focus upon something “put together”. This is the literal background of the traditional definition from von Bertalanffy (1973, p. 55):

> A system can be defined as a set of elements standing in interrelations.

In this definition, the system is “more than the sum of its parts” because there seem to be what are called non-summative (as opposed to summative) system characteristics. Given full attention to the problems of boundary setting and the influence of complexity, we could also imagine system demarcations where the system is “less than the sum of its parts”.

In the original systems movement, there was a strong emphasis on finding the systems “out there”, meaning that systems were seen as a part of the natural laws. In this respect von Bertalanffy (1973, p. 63) states that:

> … such laws are ‘a priori’, independent from their physical, chemical, biological, sociological, etc., interpretation. In other words, this shows the existence of a general system theory which deals with formal characteristics of systems, concrete facts appearing as their special applications by defining variables and parameters.

It should be understood that this conception of system initiated something new to scientific inquiry which is vividly caught by Russell Ackoff – more or less together with C. West Churchman, the other personification of the systems and operations research movement in the 1950s and the 1960s – in the quotation below (Bertalanffy, 1972, p. 11):

> In the last two decades we have witnessed the emergence of the 'system' as a key concept in scientific research. Systems, of course, have been studied for centuries, but something new has been added … The tendency to study systems as an entity rather than as a conglomeration of parts is consistent with the tendency in contemporary science no longer to isolate phenomena in narrowly confined contexts, but rather to open interactions for examination …

Many systems techniques were developed, some of which are treated later in this book, and at the same time the optimistic mood expressed led to an appreciation that the contributions from systems science meant that the higher levels in Boulding's hierarchy – see Table 1.1 – were theoretically attainable, so to speak, by making use of systems concepts, etc. A remarkable contribution was made on this question by the sociologist Walter Buckley with his *Sociology and Modern Systems Theory* from 1967. The following quotation gives a snapshot of the range, content and vocabulary of the systems movement back in the middle of the 1960s (Buckley, 1967, p. 490, underlining added):

> We have argued … that the mechanical equilibrium model and the organismic homeostasis models of society that have underlain most modern sociological theory have outlived their usefulness. A more viable model, one much more faithful to the kind of system that society is more and more recognized to be, is in process of developing out of, or is in keeping with, the modern systems perspective (which we use loosely here to refer to general systems research, cybernetics, information and communication theory, and related fields). Society, or the sociocultural system, is not then principally an equilibrium system or a homeostatic system, but what we shall simply refer to as a complex adaptive system.
>
> To summarize the argument in overly simplified form: Equilibrial systems are relatively closed and entropic. In going to equilibrium

they typically lose structure and have a minimum of free energy; they are affected only by external “disturbances” and have no internal or endogeneous sources of change; their component elements are relatively simple and linked directly via energy exchange (rather than information interchange); and since they are relatively closed they have no feedback or other systematic self-regulating or adaptive capabilities.

The homeostatic system (for example, the organism, apart from higher cortical functioning) is open and negentropic, maintaining a moderate energy level within controlled limits. But for our purposes here, the system’s main characteristic is its functioning to maintain the given structure of the system within pre-established limits. It involves feedback loops with its environment, and possibly information as well as pure energy interchanges, but these are geared principally to self-regulation (structure maintenance) rather than adaptation (change of system structure).

The complex adaptive systems (species, psychological and sociocultural systems) are also open and negentropic. But they are open “internally” as well as externally in that the interchanges among their components may result in significant changes in the nature of the components themselves with important consequences for the system as a whole. And the energy level that may be mobilized by the system is subject to relatively wide fluctuation. Internal as well as external interchanges are mediated characteristically by information flows (via chemical, cortical, or cultural encoding and decoding), although pure energy interchange occurs also. True feedback control loops make possible not only self-regulation, but self-direction or at least adaptation to a changing environment, such that the system may change or elaborate its structure as a condition of survival or viability.

We argue, then, that the sociocultural system is fundamentally of the latter type, and requires for analysis a theoretical model or perspective built on the kinds of characteristics mentioned.

At this time, systems science presented itself almost as a kind of "social physics" and the counter-reaction was not long in coming. We may detect some peak in conceptual optimism around the moon landing in 1969, which symbolised what man and technology really could achieve – given, of course, the necessary amount of resources, in this case released by President Kennedy's promise back in 1961 "to put a man on the moon by the end of the decade". The next decade saw major criticisms formulated, for example by Hoos (1972), Berlinski (1976) and Lilienfeld (1978). Among other issues raised in this debate was the failure to apply the moon landing approach (systems analysis techniques) to solving, for example, the social problems of the inner cities in the USA. Other issues concerned the real nature of systems: were they really "out there" or were they merely constructs of man's mind to deal with various phenomena?

The publication of Peter Checkland's book about *Systems Thinking, Systems Practice* back in 1981 marked the birth of what we may refer to as modern systems science. For more than two decades, this book has been a kind of "sine qua non": systems researchers, and others for that matter, interested in making use of this type of research for particular problems and otherwise, cannot avoid reflecting upon the answers that Peter Checkland came up with. In fact readers who are interested in a broad basis for understanding systems science and its many ramifications and philosophy of science premises as they appeared in the late 1970s and at the beginning of the 1980s should read the books by Lilienfeld and Checkland. The ideas and prospects of this period could then be contrasted with those of the 1950s and the 1960s, which can be found, for example, in the comprehensive presentations of Luce & Raiffa (1958) and Ackoff & Sasieni (1968). To get an overview of systems science at the beginning of the 1990s, Flood & Jackson (1991) can be recommended, and one decade later Flood (1999), Jackson (2000) and Midgley (2000). The latter four books bear witness to the fact that systems science has insights to offer with very broad appeal. Here I will constrain myself to issues where systems science can help renew planning. The following section will treat main ideas of systemic thinking.

And what is systemic thinking?

The application of systems science for the improvement of problem-solving and planning holds two promises:

- By seeing our problem or study object as a system, we may be able to make use of the systems concepts to make a better representation of it and here capture (and model) various interrelations among elements, etc. in a more qualified way.

- By seeing our problem as a system, we may be able to focus less on step-by-step approaches and capture more holistic impressions which can qualify our study.

The first view expresses what is sometimes referred to as systems analysis: we proceed by defining our problem and determining the objectives, then turn to envisage the consequences of various alternatives (often helped by models of various types), after which we appraise and select the best alternative. This is finally implemented and afterwards we may decide to monitor the implemented alternative (Leleur, 2000, p. 18). This almost generic process used in both engineering design and planning is dealt with later on in more detail. Here it suffices to note that the application of systems science as systems analysis is very much tied to the ideal of rational decision-making, where complete information is available and is processed analytically to lead to an optimal result (design, plan, etc.). I will refer to this as a *systematic approach*.

The second view simply states, as a corrective to the first one, that wholeness matters. Whereas the systematic approach above was tied to a step-by-step approach, I will tentatively define a *systemic approach* as an approach that in contrast to the systematic approach is concerned with holistic views.

In the definitions above I have introduced a twin pair of concepts which, however, are very different in respect of their background. I see the systematic concept as an off-spring of rational-analytical thinking, whereas the systemic approach is more difficult to come to grips with more precisely. To deal with this question I will make use of the viewpoints formulated by the French sociologist and philosopher of science Edgar Morin (Morin, 1974, 1985) (Leleur, 1989).

According to Morin, we need to examine the overall research patterns made use of in scientific explanation. Since the publication of a famous book by the physicist and philosopher of science Thomas Kuhn (1962), such patterns are referred to as paradigms, so we need to address relevant paradigms. Morin says that classic scientific explanation is based on a Simplicity paradigm, prescribing that complexity in the world of phenomena should be sorted out by the establishment of simple principles and general laws. Thus, in this view, complexity is perceived as the basic mode of appearance and simplicity the underlying true essence. Not surprisingly, these considerations are exemplified by the Newtonian physics of gravity and planetary movements. The content of the Simplicity paradigm is outlined as a set of various principles which govern sound scientific endeavour: science must concern universal matters and reveal invariance. Objects are separated, but deterministic laws can be discovered which explain their behaviour. Predictability thus becomes a characterising feature. Moreover, a distance exists between the perceiving subject and the objects being perceived, so that the objects are not affected or changed in any way during the examination process. The picture coming out of this is that of an automaton with linear causality. The language of the Simplicity paradigm is one of objectivity and quantity.

It is well-known – as is also the case with the recent advances in systems science and its use of analogies from non-equilibrium physics – that physics and cosmological thinking are, and have always been, major suppliers of ideas to other branches of science. It is therefore quite interesting that Morin sees the insufficiency of the Simplicity paradigm as revealed in the field of sub-nuclear physics, where newly-discovered ephemeral particles cannot be satisfactorily described.[4] Against this background, he argues for a Complexity paradigm to be formulated with the purpose of enriching not only natural science but also social science and the humanities. He formulates the Complexity paradigm as a set of principles to complement those in the Simplicity paradigm.

In the Complexity paradigm, focus is set upon local and unique matters instead of invariant forms of universal validity. Emphasis is given to organisation, autonomy and possibility, instead of determinism, dependence, and necessity. Relating to physics, the Complexity paradigm recognises asymmetric time irreversibility as an integrated part of nature's multiplicity. Other concerns are that prediction, separation, and identity have to be complemented with surprise, wholeness, and individuality. Instead of subject-object relations between perceiver and an object element, subject-subject relations need to be given attention. The picture is no longer that of the automaton, but one of an organism in its broadest sense, in a context of self-organising multi-causality. The language of the Complexity paradigm is not objectivity and quantity, but cultural interpretation and quality. Table 1.3 shows the two paradigms as formulated by Morin (1985, p. 19).

Table 1.3

The two paradigms about Simplicity and Complexity.

Simplicity paradigm	Complexity paradigm
Universality	Multiplicity
Determinism	Organisation
Dependence	Autonomy
Necessity	Possibility
Lawfulness	Self-organisation
Prediction	Surprise
Separation	Wholeness
Identity	Individuality
The general	The particular
Objects	Subject
Elements	Interactions
Matter	Life
Quantity	Quality
Linear causality	Multi-causality
The automaton	Time
Objectivity	Culture

One point being made by Morin of great relevance for our understanding of the meaning of systemic is that neither the Simplicity nor the Complexity paradigm is right per se for some reason in a concrete decision situation, with this seen as a choice between two competing approaches – or better, meta-approaches – for validating our concepts, procedures and models. The paradigms should not be thought of in the way that one should be adopted and not the other or vice versa; on the contrary, Morin argues that the paradigms should *complement* each other. They thus become remedies for each other: uncertainties invoked by making use of just one of these can be dealt with by adopting additional strategies for examination based on the other one.

The concepts of uncertainty and complementarity were worked upon by the physicists Werner Heisenberg and Niels Bohr in the mid-1920s. Fritjof Capra – known for his *Tao of Physics* from 1975 and also educated as a physicist – later on turned to systems science to formulate viewpoints on society and ecology in his book *The Turning Point* from 1982. Here he gives a really broad sweep of the societal aspects of putting more emphasis on wholeness and holistic approaches in medicine, energy and other sectors of society. Of particular interest in this context is the way he recalls the achievements of Heisenberg and Bohr (Capra, 1982, p. 68):

> It was Heisenberg's great achievement to express the limitations of classical concepts in a precise mathematical form, which is known as the uncertainty principle. It consists of a set of mathematical relations that determine the extent to which classical concepts can be applied to atomic phenomena; these relations stake out the limits of human imagination in the atomic world. Whenever we use classical terms – particle, wave, position, velocity – to describe atomic phenomena, we find that there are pairs of concepts, or aspects, which are interrelated and cannot be defined simultaneously in a precise way. The more we emphasize one aspect in our description, the more the other aspect becomes uncertain, and the precise relation between the two is given by the uncertainty principle.

> For a better understanding of this relation between pairs of classical concepts, Niels Bohr introduced the notion of complementarity. He considered the particle picture and the wave picture two complementary descriptions of the same reality, each of them only partly correct and having a limited range of application. Both pictures are needed to give a full account of the atomic reality, and both are to be applied within the limitations set by the uncertainty principle. The notion of complementarity has become an essential part of the way physicists think about nature, and Bohr has suggested that it might also be a useful concept outside the field of physics.

I have adopted the ideas of the Simplicity and Complexity paradigms and their complementarity as issues relevant for a first and most basic orientation towards a given decision situation or socio-technical design task, be it organisational change, marketing of a new product, planning of a new facility, etc. Specifically, I see systemic thinking as rooted in the Complexity paradigm, whereas systematic thinking – in line with many topics as they are taught in the various subject curricula at university or vocational school – as rooted in the Simplicity paradigm. Consequently, systemic thinking does not grow out of isolating it from systematic thinking but out of seeing it as unfolding from an interplay with more systematic considerations for each decision situation or design task.

As a consequence, systemic in my presentation can take on rather broad interpretations. With wholeness as just one of the constituting concepts of the Complexity paradigm – see Table 1.3 above – we obtain a wide basis for the explorations to be carried out relating to concepts, methods, processes, etc. Such a wide basis is quite challenging, with the purpose of systemic thinking here being to inform and qualify planning practice.

Earlier on, one point made by Flood on boundary setting was about making a choice: what is included and taken into account and what is not. I may add that adoption of a proper paradigm is not about making a choice between the two paradigms, cf. the discussion above; both paradigms will probably be of relevance, with the particular extent of each to be interpreted in the concrete situation by the analyst – or may I say the systemicist – to emphasise the dual role that I foresee for the systemic planner. Taken separately, I do not believe that one of the paradigms can exhaust the examination: each task – given a set of boundaries chosen for the system demarcation in the study, either temporarily or possibly more permanently – needs to be reflected upon by drawing upon both the Complexity paradigm and the Simplicity paradigm. The explorative potential of systemic thinking thus foreseen can be well illustrated by the following quotation stemming from Niels Bohr (Heisenberg, 1971, p. 102):

> The opposite of a correct statement is a false statement. But the opposite of a profound truth may well be another profound truth.

The basic ideas of systemic planning

By unfolding the content of the Complexity paradigm through different themes, our notion of systemic thinking will take on a broader and more multi-faceted meaning than is contained within the conventional definition of systemic in the systems literature based on “interconnectedness” and “holism”.[5] As already stated, I am aiming at an operational and practical use of systemic thinking. Most immediately, this will impact on the remainder of this presentation of the basic ideas of systemic planning.[6]

So far we may summarise as follows:

- Three types of complexity have been identified, namely detail complexity, dynamic complexity, and preference complexity. Concerns with regard to the “means”, “path” and “ends” should be based on explicit consideration of possible influences from one or more of these complexities.

- With regard to problem types, one of the categorisations described operates with closed, contained and open-ended problems. Depending on the task in hand systemic thinking may play a larger or smaller role. When dealing with open-ended problems, often involving a long-term view with many stakeholders, I foresee systemic thinking as of major importance, whereas dealing with closed problems I foresee that these what we might term standard problems can be dealt with in a reasonable way by a systematic thinking approach. Last but not least I foresee that in many situations a combination of systemic and systematic thinking can be recommended.

- Systemic thinking is rooted in the Complexity paradigm and systematic thinking is rooted in the Simplicity paradigm. Both types of thinking thus take on broad possibilities for interpretation and unfolding in the concrete task. The two paradigms should be used in a complementary way for problem-solving and decision-making.

Planning in public and private organisations and enterprises[7] is concerned with foresight and the provision of decision support for the formulation and implementation of projects, programmes and policies. What characterises the systemic planning approach is that it seeks to take the complexity and uncertainty – or better: the complexities and uncertainties – into account by scrutinising and combining different methods and processes that may be relevant in the actual planning task. Thus methods and process-layouts become contingent, i.e. dependent upon concrete circumstances. For this reason, I see systemic planning as a kind of “second-order exploration”, whereas on this view conventional planning can be seen as “first-order” exploration making use of a pre-established set of methods and process-diagrams.

The planning definition adopted above is well in agreement with theory and practice as it has developed so far, see e.g. Banfield (1973), Lichfield et al. (1975, pp. 19-22), Hudson (1979, p. 387), Alexander (1986, pp. 43-56), Friedmann (1987, pp. 37-38), Friedmann (1996, pp. 21-24), Lichfield (1996, pp. 12-17) and Khisty & Mohammadi (2001, pp. 14-17). With the systemic dimension added, as it were, it serves to generalise and radicalise planning, and makes it suitable for application in wider, more complex contexts. The challenge of making systemic planning worthwhile and operational lies therefore in getting to grips with possible types of exploration that could be undertaken. So far, we can give exploration in a planning context the following connotations:

- Optimisation
- Scanning
- Assessment
- Learning

This in no way exhaustive list of possible exploration "modes" can be reflected upon making use of the ideal-typical decision model. Below, this is formulated in a version by Friedmann (1996, p. 22):

1. Formulation of goals and objectives.
2. Identification and design of major alternatives for reaching the goals identified in the given decision-making situation.
3. Prediction of major sets of consequences that would be expected to follow upon adoption of each alternative.
4. Evaluation of consequences in relation to desired objectives and other important values.
5. Decision based on information provided in the preceding steps.
6. Implementation of this decision through appropriate institutions.
7. Feedback of actual programme results and their assessment in the light of the new decision-situation.

With no uncertainty and complete predictability, our exploration mode becomes one of optimisation; operations research methods, systems analysis techniques, can then be applied: simulation, linear programming, etc. With less ideal circumstances, other exploration modes become relevant: we need to scan, to assess, to learn, etc. This means that the ideal-typical model becomes less useful when our planning problems are "open-ended", "messy", "wicked" or however we would choose to characterise them.

Some kind of solution when facing less ideal circumstances could be to "approximate" the ideal-typical model in the best possible way. With this kind of approach to such a situation, we would still make use of first-order exploration. Another approach, however, could be to develop and apply what has been termed second-order exploration on the basis of the ideas of systemic thinking. To get a closer understanding of the possibilities and limitations of such a systemic planning approach, we will need – quite literally – to explore the meaning of exploration in planning. This will take us through systems science issues in Chapter 2, communication and methodology issues in Chapter 3, and societal conditions in Chapter 4 to be wrapped up in the final section of that chapter as a listing of competences needed to carry out systemic planning. This is seen as the primary practical result of the examination undertaken in this book. In an Epilogue following Chapter 4, the findings are reflected upon more theoretically by comparing complexity as a research orientation with other current research approaches to estimate the potential of the complexity research approach. Two added appendices exemplify some of the methodological recommendations in a more specific and technical way, while a third appendix presents some proposals for further development.

CHAPTER SUMMARY

The chapter has introduced *three types of complexity: detail, dynamic and preference complexity*. Together with different types of occurring planning problems – differing as concerns their combinations of means and ends – this has shown *that there is a need to consider planning in a way that makes it possible to apply planning also on open-ended, complex problems*. Some first steps towards developing planning into this direction were taken by introducing the ideas of systems science and systemic thinking and by paying attention to the different nature of the two described paradigms about simplicity and complexity. These are referred to simply as *the Simplicity and Complexity paradigms* as they are recurrently made use of throughout the book. As a point of departure for the ideas and methodology of systemic planning being the general theme for treatment in the chapters to follow, *a generic version of conventional planning* was finally presented in Chapter 1 as a seven-stage ideal-typical decision model. The shortcomings of this model are the challenge of systemic planning as an approach suitable for planning in a complex world.

Notes

1. Table 1.1 has been adapted from Khisty & Mohammadi (2001, p. 7).
2. For a highly entertaining treatment of emergence, see Johnson (2001). Clayton (2004) is also a very relevant but more technical reference.
3. The name Butterfly Effect can be associated with the picture arising when making a graphic representation of the so-called mathematical attractor, which looks like a mask shaped object. An attractor is the shape the dynamics converges toward given enough time. The dynamics, however, having reached the attractor will promptly diverge again. Anything off a dynamic attractor is "folded" toward it, while anything on it is "stretched" in an unpredictable way. The only predictable thing is that it will stay on the attractor, but here the behaviour is complex and unpredictable (Cohen & Stewart, 1994, pp. 206-207).
4. Morin refers, among other things, to the wave-particle discussion in quantum mechanics, see, for example, (Beiser, 1967, pp. 125-138), and he goes on to state (Morin, 1974, p. 556): "… today it is even a moot question whether the concept of an elementary particle has any meaning".
5. Such definitions can, for example, be found in Flood (1999) and Midgley (2000). The meaning of systemic in this context has been made more explicit by making use of Morin's paradigm concepts.
6. Systemic planning has been chosen as an appropriate term for the wider approach to planning advocated in this book. So conventional planning can be seen as indicating systematic planning. Since systemic planning is seen as including the conventional approach – being a proper planning approach for many problem types – the systemic approach can make use of – or be rooted in – both the Simplicity and the Complexity paradigms depending on the actual conditions.
7. Sometimes in the planning literature, planning seems to be associated either with the public sector, town planning as dealt with in texts for

engineers, geographers and administrators for example, or with the private sector; with regard to the latter, corporate strategic long-term planning could be an example. In this book planning will in principle not be treated differently with regard to such a public-private division. The aim is to treat the general ideas of planning that necessarily will always have to be adjusted – "bent" – to accommodate the conditions relating to their concrete application.