Chapter 1
Introducing Systems Approaches

Martin Reynolds and Sue Holwell

Abstract The five approaches covered in *Systems Approaches to Making Change* – System Dynamics (SD) Viable Systems Model (VSM), Strategic Options Development and Analysis (SODA: with cognitive mapping), Soft Systems Methodology (SSM), and Critical Systems Heuristics (CSH) – are introduced. The rationale for their inclusion is described based on their (i) common historic emergence in dealing with complex situations of change and uncertainty, (ii) shared potential and actual constructivist use of the systems idea, and (iii) pedigree of adaptability and versatility of tools in working with other approaches to making change.

1.1 Overview

Systems Approaches to Making Change brings together five systems approaches to managing complex issues, each having a proven track record covering many decades. The five approaches are:

1. System Dynamics (SD) developed originally in the late 1950s by Jay Forrester
2. Viable Systems Model (VSM) developed originally in the late 1960s by Stafford Beer

M. Reynolds (✉)
School of Engineering and Innovation, The Open University, Milton Keynes, UK
e-mail: martin.reynolds@open.ac.uk

S. Holwell (Retired)
The Open University, Milton Keynes, UK

M. Reynolds, S. Holwell (eds.), *Systems Approaches to Making Change: A Practical Guide*, https://doi.org/10.1007/978-1-4471-7472-1_1

3. Strategic Options Development and Analysis (SODA: with cognitive mapping) developed originally in the 1970s by Colin Eden
4. Soft Systems Methodology (SSM) developed originally in the 1970s by Peter Checkland
5. Critical Systems Heuristics (CSH) developed originally in the late 1970s by Werner Ulrich

The accounts of the approaches that follow draw heavily on the extensive experience of the contributing authors. They are more than experienced practitioners, they bring the added quality of academic rigour to the reflection on practice that characterises their work. Drawing on the extensive experience of these contributing authors, some of whom are primary originators, this volume is an accessible exposition of the fundamentals of five compatible but different approaches, and in addition provides an opportunity to update guidance on the use of each approach.

We begin by examining, first, the nature of the complex situations to which systems approaches generally make a claim towards improving. Second, we examine how systems thinking might help manage complex situations more effectively. Third, some perspectives on the nature and development of systems thinking underpinning contemporary systems approaches are explored. Fourth, we provide our own perspective and rationale for the selection of the five approaches chosen. Fifth, a brief description of each approach is given. Finally, we outline the common framing behind each of the core chapters.

1.2 The Way of the World

It is Easter week 2009. A quick glance at the news media reveals several stories arising from complex situations calling for better human intervention. Here are just three such stories:

2009 is the twentieth anniversary of the Hillsborough football stadium disaster. Many people in the UK are joining with the families of the ninety six football supporters who were crushed to death shortly after the start of a FA Cup semi-final match between Liverpool and Nottingham Forest at the Hillsborough football ground in 1989. Although in reaction to the tragedy many improvements in the safety of football grounds have been generated, there remains a considerable sense of injustice amongst the families and friends of the deceased that no one has been held to account. In 1990 an official inquiry, which many considered flawed because it failed to give due voice to junior police officers and eyewitnesses, handed down the verdict of accidental death. Harrowing stories about victims who might have been saved continue 20 years on amidst growing evidence of confusion, non-communication, and general lack of leadership amongst emergency services, of police mismanagement and a subsequent police cover-up (senior police officers vetting statements presented to the inquiry), as well as some misguided tabloid news provocation. Aside from the bereaved families, for many groups of people associ-

ated with the football industry including the police, the circumstances of that afternoon, remain highly problematic.

The second story relates to a continuing saga of sea piracy – apparently the biggest industry for the troubled African country of Somalia. Individual pirates are among Somalia's wealthiest men. Using sophisticated equipment and modern weaponry, the pirates hijack sailing boats and large cargo ships, treating the ship, its cargo and its crew as hostages for ransom. Given the open seas in which they operate, there appears to be little hope of such attacks being curtailed: there is little chance of an effective military reaction, and little chance of the sea bandits ever facing justice. Although the Easter headline news focused on the deaths and rescue attempts of European and American victims of piracy, the effects of Somalia's sea bandits are far reaching. For the Seychelles it involves the loss of fishing grounds. For Kenya, there have been significant effects on tourism. Cruise ships have begun avoiding East Africa because of the piracy risk, thereby rendering thousands of Kenyan tourism workers jobless. Longer sea routes around Africa to avoid using the Suez Canal have increased costs for shippers and consumers. And Somalia itself is affected because ship owners are reluctant to take on UN contracts transporting the food aid that feeds half of Somalia's eight million people. Only with an expensively deployed European Union naval force were ships' crews willing to make the dangerous aid run into Mogadishu.

The third story is at first sight, and in fresh contrast, more agreeable and hopeful. In the mountainous forests of Indonesia environmentalists have discovered a population of Orangutans – one of the world's most endangered species of apes. Since the 1990s the rainforests in Indonesia have been systematically destroyed by burning at an alarming rate as plantation owners want more land for the production of Palm oil. Palm oil has become very lucrative because it is classed as a clean burning fuel. This fuel is at a premium as an ever demanding global population wants a source of fuel energy not dependent on the politics of crude oil supply and/or having the 'label' of being environmentally benign. The discovery of the Orangutans brings in to sharp relief the politics of food production, energy production, local livelihood strategies (including the widespread very poor working conditions of plantation workers), and of course conservation. Some experts estimate that the animals could be wiped out within two decades given the current rate of habitat destruction.

1.2.1 Big, Big Issues

So what might we learn from these three contrasting stories about the situations in which systems approaches might be helpful? Firstly, they illustrate how localised issues have causes and consequences that have a much wider impact. The Hillsborough disaster represents not just 'a problem' or 'difficulty' of infrastructure design and safety, but invites concerns ranging from basic community relations and policing methods, emergency service training, right through to the responsibilities of the media, politicians, and those financially benefiting from the football industry,

even including football sponsors. The Hillsborough story continues to unfold and its consequences on the culture of football are not bounded by national frontiers. Similarly, the localised 'problem' of piracy in a country torn by war and conflict over the past 20 years is not one confined to the offshore waters of Somalia or one that can be easily 'fixed' by military or policing actions. There are many interrelated and interdependent factors involved, with contrasting perspectives on the situation that range from the rights of law-abiding Somali citizens wishing to develop livelihoods, to traders and tourists wanting to travel freely and safely, to sections of a community brutalised and attracted by greed into criminal activity. For the threatened communities of Orangutans, and conservationists concerned with their survival, the 'difficulty' is not just located in the mountainous forests of Indonesia but extends nationally and globally; to national logging concessions and the displacement of villagers from their forest dependent livelihoods, to global trade agreements on fuel. The ongoing, and growing, international concern and high level conversations over climate change suggest that matters of nature and conservation can no longer be regarded as localised issues, but rather are matters that should concern all of us.

In short, our three stories taken from a single day's news coverage over an Easter week-end in 2009 illustrate how localised issues can be translated into many big, big issues. They also illustrate how big issues are characterised by multiple and often conflicting perspectives. There are of course other big issues confronting us on a daily basis. As a backdrop to Easter 2009 we were continually reminded of the world crises of banking collapses, alongside increased abject poverty, and ecological dilemmas alongside increasing demand on natural resources. The G20 group of world leaders from the world's most powerful 20 economies attended an economic summit in London in March 2009. This was a meeting to tackle the worst economic situation since the 1930s Depression, a situation that is affecting both developed and less-developed countries. Also in the news at that time and now are the increasingly familiar stories on the melting of huge swathes of the Antarctic ice shelf and predictions of growing shortages of fresh water supply that will have consequences more far reaching than the shortage of oil.

These are big, global issues and could be categorised as issues of sustainability and development, but categorizing such issues does not give any indication about how they may be resolved. At the same time on a national level we face issues in our societies: children living in poor and violent neighbourhoods, an aging population with growing demands for care, how to manage policing in times of terrorist threat and still maintain civil liberties that have been hard won. In our organisations we are constantly trying to adapt to changing circumstances, whether it is for the public sector organisation new government legislation and/or targets forcing re-thinking of process, staff and structure or for the private sector organisation engaged in fierce competition beset by consumer demands and expectations. And for all, rapidly developing technologies can and do significantly change the environment for many organisations and their members.

And as individuals we face our own challenges, whether they be confronting our family concerns of 'what to do about grandpa' or overcoming substance abuse or,

on a more fortunate footing, deciding where to go on holiday given some of the big issues above.

Human life is not often simple and straightforward, either professionally or personally. So what is the relevance of this to a book about systems approaches? To answer this, look at the kind of issues above; there are no obvious answers about what to do, different people will see different priorities, and when we begin to make changes unintended (and sometimes unwelcome) consequences emerge.

1.2.2 Messes and Difficulties

Issues of concern to us vary enormously in terms of their complexity and seriousness, from minor hiccups to near-catastrophe, and we can think of all issues falling somewhere on a continuum between minor and straightforward to very complex and crucial. We can label one end of the continuum as being a 'difficulty' and the other a 'mess' (the term coined by Ackoff 1974). We can distinguish between the concept of a mess, and a difficulty, in several ways.

Messes usually have more serious implications; more people are likely to be involved; they include *many interlocking aspects* and may appear in different guises. As our three stories illustrate, messes usually have a longer time-scale; and they are often more complicated in terms of having many interdependent factors, than a difficulty. In addition to these broad characteristics there is a crucial difference between a difficulty and a mess and that is the extent of *uncertainty*.

If a situation is a mess there is much about it that is uncertain. The uncertainty starts with the situation itself: a mess is hard to pin down; it's difficult even to say what the situation of concern actually is, or what the source of the unease is, and yet things feel not right. With a difficulty we know roughly what an answer will look like: with a mess, we are not at all sure, not least because there are likely to be multiple possible trajectories. Indeed, with a mess it usually doesn't make much sense to talk about 'an answer'. It's more a matter of coping with the circumstances as best one can. With a difficulty we can take for granted the overall context and purpose of the activity; it's simply a matter of how it can best be done. But a mess calls into question priorities and assumptions; and raises questions about how much weight to give to different elements and viewpoints. Moreover, with a mess more aspects are beyond direct control. In short, a mess includes many different and changing perspectives and consequential actions, which contribute towards the overall level of uncertainty.

Some authors characterise a mess in terms of two dimensions, rather than a single continuum. Firstly, there is the multitude of factors that contribute to the scale of the situation. All three stories above have considerable histories attached to them as well as invoking multiple dimensions in terms of interrelated and interdependent human and natural variables, ideas and events. Secondly, a mess is characterised by significant levels of uncertainty, and this in turn is associated with there being multiple and, as evident in the three stories, often conflicting, perspectives on the situa-

tion. The first dimension alone signals the continuum from a simple difficulty, where few variables are involved, to a complicated difficulty. When the second dimension comes into play – dealing with uncertainty and multiple perspectives – this signals an engagement with a complex mess. Whereas difficulties, no matter how complicated, can be conceptualized in a straight-forward way and then worked upon, messes are experienced as being much more difficult to get to grips with conceptually.

Systems approaches aim to simplify the process of our thinking about, and managing, complex realities that have been variously described by systems thinkers as messes (Russell Ackoff), the swamp (Donald Schön), wicked problems (Horst Rittel), or in relation to environmental issues, resource dilemmas (Neils Röling). You may have come across the acronym VUCA (volatility, uncertainty, complexity, and ambiguity) sometimes used in management speak to describe messy situations. Systems thinking provides ways of selectively handling the detail that may complicate our thinking in a transparent manner, in order to reveal the underlying features of a situation from a set of explicit perspectives.

1.2.3 Traps in Conventional Thinking

Before examining how systems thinking might help our engagement with messes, let us look at how more conventional thinking can be counterproductive in resolving complex issues. Many aspects of our traditional thinking stem from confusing what is a mess with a simple or even complicated difficulty. For example, it is not unusual to approach the situations described in the three stories by adopting one or more of the following positions.

- Interconnections can be ignored – imagining that the survival of Orangutans has nothing to do with our own lifestyles – rather than looking at the bigger picture.
- A single cause may be assumed – tragic deaths of football supporters from inadequate physical football stadium physical infrastructure – rather than there being multiple interrelated causation.
- It may be assumed that an individual is to blame – a villainous pirate – rather than attempting to understand the ways in which a situation arose that led to a problematic outcome.
- There may be a focus on outcomes (and thus only on what can be measured) – numbers of Orangutans, all-seated football grounds, prosecution of pirates – rather than the processes by which beneficial change might best occur.

This last feature of traditional thinking has widespread relevance in Western societies blighted by the culture of targets, performance indicators and ‘best’ practice. Simon Caulkin, commenting on targets in the British National Health Service in a piece titled ‘This isn’t an abstract problem. Targets can kill’ in the Observer newspaper on March 22, 2009 wrote:

> The Health Commission's finding last week that pursuing targets to the detriment of patient care may have caused the deaths of 400 people at Stafford between 2005 and 2008 simply confirms what we already know. … [T]argets distort judgment, disenfranchise professionals and wreck morale. Put concretely, in services where lives are at stake – as in the NHS or child protection – targets kill. Targets make organisations stupid. Because they are a simplistic response to a complex issue, they have unintended and unwelcome consequences – often, as with MRSA [infectious disease picked up in hospitals] or Stafford [hospital], that something essential but unspecified doesn't get done. So every target generates others to counter the perverse results of the first one. But then the system becomes unmanageable.

In summary, the traps of non-systems thinking lie in two simple dimensions; firstly avoiding the inevitable interconnectivity between variables – the trap of *reductionism*, and secondly, working on the basis of a single unquestioning perspective – the trap of *dogmatism*.

1.3 Systems Thinking Can Help

1.3.1 Systems Are Social Constructs

There are two major standpoints on the nature of *systems* that shape and distinguish different systems approaches. Cabrera et al. (2008) describe them in terms of the distinction made between 'thinking about systems' (e.g., accounting systems, personnel systems, ecosystems, health systems, legal systems, etc.) and 'systems thinking'. Elsewhere these traditions have been similarly referred to in terms of 'hard' and 'soft' systems thinking (Checkland 1978; Jackson 1982). Both traditions have relevance and significance. More formally, the distinction is expressed in terms of the relative emphases of ontological traditions (systems as representing real world entities) and epistemological traditions (systems as learning devices to inquire into real world entities).

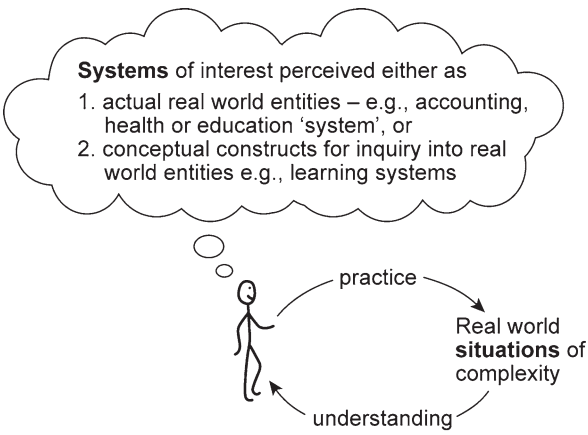

Fig. 1.1 Systems thinking and thinking about systems in a constructivist tradition

There is now agreement amongst systems practitioners that systems are *ultimately* conceptual constructs, and as such contemporary systems approaches can be regarded as belonging to a constructivist tradition. In short, 'systems' are constructs used for engaging with and improving situations of real world complexity (see Fig. 1.1).

Keeping this constructivist idea in mind, we can then examine two key aspects of systems thinking.

1.3.2 Two Aspects of Systems Thinking

> The core aspects of systems thinking are gaining a bigger picture (going up a level of abstraction) and appreciating other people's perspectives (Chapman 2004, p. 14)

The perspective on systems thinking that we use builds on this simple distinction made by Jake Chapman, which in turn builds upon the distinction made by Richard Bawden in identifying two transitions implicit in the history of systems thinking: one, towards holism, and another towards pluralism (Bawden 1998). The two transitions counter reductionism and dogmatism respectively. These two aspects are referred to in many guises by systems practitioners and writers. One of the most influential of these is C. West Churchman (1913–2004). Churchman described systems both as a process of unfolding, by which he meant heroically 'sweeping-in' as many factors as possible to our systems of concern, and as a process of looking at things from different viewpoints or, as he first coined the term, 'worldviews'. In this latter aspect, his description of a systems approach – *"A systems approach begins when first you see the world through the eyes of another"* (Churchman 1968, p. 231) – remains one of the most frequently quoted descriptions of systems thinking.

So how might we characterize these two aspects of systems thinking? Firstly, systems thinking is about gaining understanding by looking at the relationships between things. Most formalised thinking, including most scientific thinking and indeed most academic endeavour, tries to understand something by pulling it apart. By focusing on relationships you discover how something works by its effects on what surrounds it. Most people recognize they have been in situations where they 'can't see the wood for the trees'. Systems thinking is precisely about changing the focus of attention to the forest, so that you can see the trees in their context. Understanding the forest gives new and powerful insights about the trees. Such insights are completely inaccessible if one concentrates on the individual trees. So, systems thinking is a way of looking at (and making sense of) the world. It is based on an understanding that if one considers a situation as a whole, rather than focusing on its component parts, then there are properties which can be observed which cannot be found simply from the properties of the component parts.

Secondly, systems approaches start with the situation, with its complexity and uncertainty, where an acknowledged part of the problem is to establish and agree

what the problem is, and where there will rarely be a single 'right' resolution. So the language of systems is about problem-situation rather than problem, and of resolution (improving the situation) rather than solution (solving the problem). Within complex situations involving multiple interrelated factors including multiple human interests, progress can be made as part of a process of inquiry in searching for, or thinking of relevant wholes, what in systems terminology are sometimes referred to as *systems of interest*. These are *sets of activity which could be described as being organised around a single/particular purpose.*

Such wholes are not pre-determined or existing. Rather they are selected, or identified by someone for a purpose – generally to learn about the complex situation in order to do something about it (change it, improve it). Given that when dealing with a 'mess' what counts as resolution is not clear at the outset then progress in a systems inquiry comes partly from learning what will count as resolution as the inquiry progresses.

1.3.3 Four Perspectives on Systems Thinking

Systems approaches have a rich historical tradition. Systems thinking in terms of promoting holistic views – particularly emphasising the integral relationship between human and non-human nature – can be traced back to the ancient spiritual traditions of Hinduism (e.g., through ancient texts like the Upanishads and Bhagavad Gita), Buddhism (oral traditions of the Dhama), Taoism (basis of acupuncture and holistic medicine), sufi-Islam (in translations of the *Kashf al-Mahjûb* of Hujwiri, and the *Risâla* of Qushayri), ancient Greek philosophy (particularly Hericles and Aristotle), as well as being prevalent through the oral traditions of many indigenous tribal spiritual traditions which have existed for tens of thousands of years. The term 'systems' as recognised in contemporary usage, predominantly in Western cultures, was explicitly used first in eighteenth century European philosophy rooted in the works of Immanuel Kant (Ulrich 1983).

Bawden's two aspects of systems thinking – being holistic and being more pluralist – can be used to review systems approaches themselves. There are many different strands of systems thinking, and different perspectives on how to group them. So much so that whilst professing to deal with the complexities of real world situations in a manageable manner, we may well have inadvertently created a complex clutter of systems approaches. There have been many publications about systems thinking and practice in the 70 years since Bertalanffy published his first papers on systems theory. The four volume publication *Systems Thinking* by Midgley (2003) has nearly 100 chapters each dealing with a particular method and in 2001 Eric Schwartz identified 1000 "streams of systems thought (http://www.iigss.net/gPICT.jpg). The 1997 International Encyclopaedia of Systems and Cybernetics (François 1997) had 3000 entries. So in the systems field there is no shortage of approaches; it is diverse with many concepts,, methods and techniques.

With the large number of 'systems approaches' it is not surprising that there are several ways of thinking about how systems approaches relate to each other and doing this produces different typologies. Typologies can themselves be regarded as system models; particular perspectives on organizing the interrelationships between different entities, each associated with a particular purpose. Here we briefly look at four 'typologies' or perspectives. As with any model, viewpoints are inevitably partial in the sense of being both incomplete and of being viewed from a particular or partisan perspective necessarily based on its own particular purpose. The following short overviews of these four perspectives represent a gradual shift in focus from the systems approach itself, to the situations in which they are used, and finally to the user.

Perspective 1: Three Traditions of Systems Thinking (West Churchman, Peter Checkland, Werner Ulrich, Mike Jackson and Others)

That traditions of systems thinking categorized as three sets – 'hard', 'soft' and 'critical', is perhaps the most widely used way of classifying systems approaches. It is intended to recognise prevailing systems approaches whilst also legitimizing new ways of thinking. The distinction is one that builds on Peter Checkland's earlier distinction between hard and soft systems. Checkland (1978) suggested that systems thinking prevailing at the time had rested on an unspoken assumption that systems exist in the real world. Checkland's questioning, and subsequent abandonment, of this 'hard' systems assumption paved the way for an extensive and influential program of 'soft' systems action research based on the position that systems are epistemological constructs rather than real world entities. Meanwhile Churchman's student, Werner Ulrich, and others including Mike Jackson and colleagues at Hull

Table 1.1 Three traditions of systems thinking

Systems 'type'	Selected systems approaches
Hard systems	General systems theory (Bertalanfy 1956) Classical (first order) cybernetics, 'mechanistic' cybernetics (Ashby 1956) Operations research (Churchman et al. 1957) Systems engineering (Hall 1962) Socio-technical systems (Trist et al. 1963) RAND-systems analysis (Optner 1965) System dynamics (Forrester 1971; Meadows et al. 1972)
Soft systems	Inquiring systems design (Churchman 1971) Second order cybernetics (Bateson 1972) Soft systems methodology (Checkland 1972) Strategic assumption surface testing (Mason and Mitroff 1981) Interactive management (Ackoff 1981) Cognitive mapping for strategic options development and analysis (Eden 1988)
Critical systems	Critical systems heuristics (Ulrich 1983) System of systems methodologies (Jackson 1990) Liberating systems theory (Flood 1990) Interpretive systemology (Fuenmayor 1991) Total systems intervention (Flood and Jackson 1991a) Systemic intervention (Midgley 2000)

University, identified the need for a distinct third systems thinking strand. Critical systems thinking (CST) shares the same epistemological shift as the soft systems tradition but addresses some of the perceived inadequacies in both hard and soft systems thinking, most notably the inadequate consideration of power relations. Table 1.1 is an example of grouping systems approaches using this schema.

Gerald Midgley uses the three distinctions in Table 1.1 to describe the historical evolution of current ideas of systems thinking and practice as evolving through a series of three "waves", or phases of inquiry (Midgley 2000). Each wave relates to a particular focus of the systems field which brought with it a new set of methods. Wave 1 focused on concrete issues of 'problems' and problem solutions for issues where there was perceived unity of purpose. Wave 2 began with the wider soft systems perspective on people and their perspectives on issues. And Wave 3 introduced added emphasis to power relations and how they affect what problems are addressed, and how they are perceived.

Whilst the three-part model remains very influential, not least because it addresses similar discourses in other disciplines, particularly those sharing ideas from critical social theory and Habermas' three knowledge constitutive interests (Habermas 1972, 1984), some difficulties are associated with the terminology of 'hard' and 'soft' as these have particular gendered connotations which can be difficult to discard. Other terms from critical social theory like functionalist, interpretivist, and emancipatory are sometimes substituted (cf. Jackson 2000). Another perceived difficulty is the limitation of defining systems thinking only in terms of these three categories. Does it not close up space for other potential synergies?

A question arising from this characterisation of systems approaches is what guidance would a practitioner find useful for using the different approaches in different situations. The focus here shifts towards the situation.

Perspective 2: Systems Thinking for Situations (Mike Jackson and Bob Flood) The perspective here addresses the question of how might practitioners in different situations be guided in making use of the range of systems approaches available. System of systems methodologies (SOSM) builds on the triadic model associated with Perspective 1 with the primary aim to create a classification of systems methodologies that would allow for their complementary use in specified problem situations (Jackson 1990). The important shift in focus here is towards the situations in which systems approaches are applied. SOSM provides a matrix for classifying systems methods on two dimensions: one, the level of complexity of the problem situation (simple or complex), and the other, the degree of shared purpose amongst participant stakeholders (unitary, pluralist, or coercive relationships). It is this latter dimension that draws on the hard, soft, critical typology using metaphors as guiding principles – machine for the 'hard', living organism for the 'soft' and the metaphor of prison for the 'critical' situations. The classification yields a six celled matrix as illustrated in Table 1.2. Each cell defines a problem situation which then invites particular suitable systems methods.

The two dimensions of situations are helpful in delineating the two aspects of systems thinking described above. The simple/complex dimension relates to levels

Table 1.2 System of systems methodologies (Adapted from Jackson 2000, p. 359)

		Participants		
		Unitary 'hard' systems based on machine metaphor	Pluralist 'soft' systems based on organismic metaphor	Coercive 'critical' systems based on prison metaphor
Problem situations	Simple	Simple unitary: e.g. systems engineering	Simple pluralist: e.g. Strategic assumption surfacing and testing	Simple coercive: e.g., critical systems heuristics
	Complex	Complex unitary: e.g., systems dynamics, viable systems model	Complex pluralist: e.g. soft systems methodology	Complex coercive: (non available)

of interrelatedness and interdependencies, and the unitary/pluralist/coercive dimension relates to levels of engagement with multiple perspectives. Again such a model has been helpful in prompting systems practitioners to think more clearly about the nature of the problem situation – the 'mess' – in a simplified manner. It has helped with the appreciation that different systems methods might complement each other and indeed complement other approaches used for similar problem situations. Later, SOSM was adapted and became embedded in total systems intervention (TSI) by (Flood and Jackson 1991a, b) – a methodology for drawing different methods together through a three-fold process of (a) creatively exploring problematic situations, (b) choosing an appropriate systems approach, and (c) implementing it.

There are two significant difficulties in using this model. One is in assuming from the outset that a problem situation can somehow be easily identified as constituting one of the six 'problem situation' types depicted in the cells of the matrix. Another difficulty is in the 'fixing' or pigeon-holing of particular systems approaches as being only suitable for specific types of situation. First, there may be different opinions on where different systems approaches 'fit' based upon actual experiences of using the approach. Many approaches, though understood as having roots in particular traditions, can be used for different purposes (Reynolds 2015). So for example, whilst some may classify VSM as a 'hard' approach – in the tradition of classic first order Cybernetics – others would describe the VSM as an interpretivist or even an emancipatory approach. Similar arguments may be expressed in relation to other approaches, particularly socio-technical systems and systems dynamics, both of which have many 'softer' and more 'critical' dimensions depending on the context of use and the user. Second, such pigeon-holing detracts attention from the potential for systems approaches to evolve and develop through use in different contexts by different users.

The perspective here and in the previous model prompt questions about other related traditions and approaches that might influence systems thinking, along with the influence of their domains or situations of interest. How might systems approaches draw upon and develop synergies with complementary traditions of practice and theory?

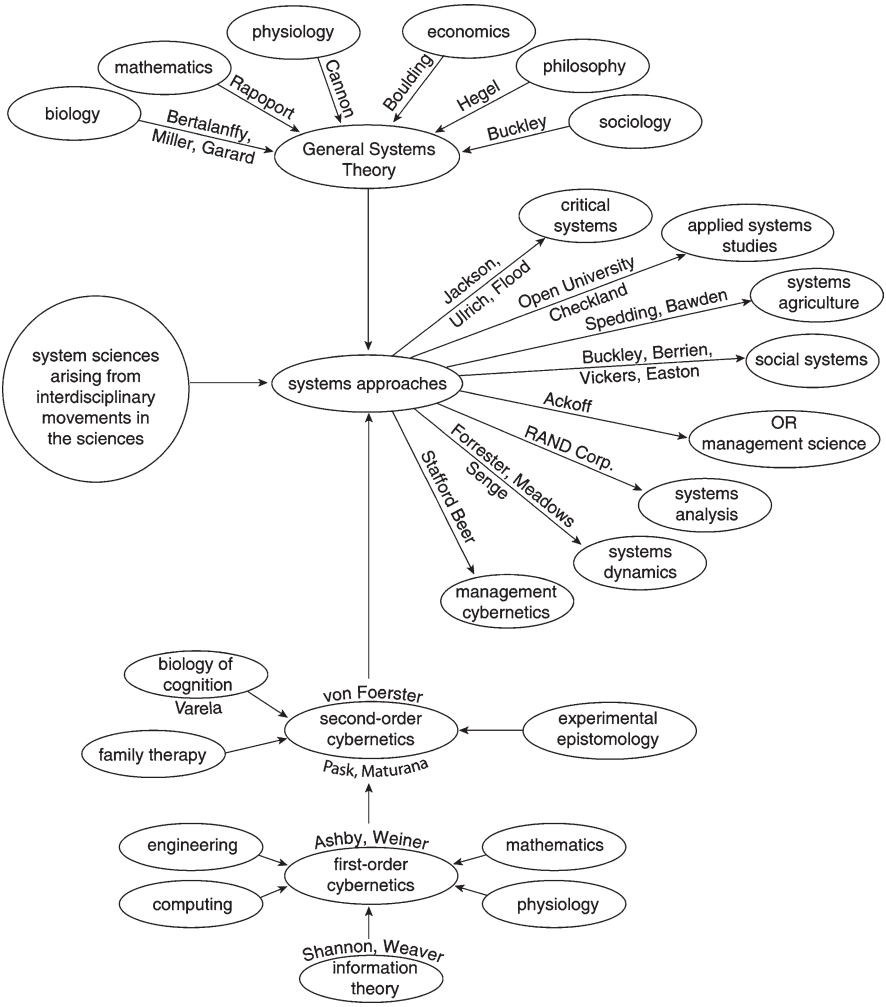

Fig. 1.2 An influence diagram of different systems traditions which have shaped contemporary systems practice (Maiteny and Ison 2000). Reprinted from Ison, R.L., Maiteny, P.T. and Carr, S., 'Systems Methodologies for Sustainable Natural Resources Research and Development', *Agricultural Systems*, p259, Copyright (1997), with permission from Elsevier

Perspective 3: Influences Around Systems Approaches (Ray Ison and Paul Maiteny)

This perspective illustrates some key relationships between different systems approaches and other closely related traditions. The authors were particularly concerned about the tendency of systems practitioners to be self-referential and insular. They wanted to recapture some of the wider influences and cross-fertilisation that continues to generate innovative development of systems approaches. The aim was to broaden the understanding and practice of spheres of influence both with respect

to other *approaches* outside the traditional systems toolbox, and to other *situations* of interest in which such approaches were evident (Fig. 1.2).

Some difficulties arising from such a perspective can be mentioned. Firstly, there are only one-way influences, whereas of course influences tend to be more dynamic (for example, family therapy has been significantly influenced by systems approaches). Secondly, whilst arguably casting a wider net than prevailing perspectives (Tables 1.1 and 1.2), some significant contributors such as C. West Churchman appear not to be present. The difficulties raise some important questions though. A key question is how might systems practice develop synergies with other practices in different domains in order to keep alive its essential dynamism, and to maintain or raise its profile as being relevant to a range of complex situations in contemporary society. How might we ensure that systems thinking is not just sectioned off as just another academic discipline amongst the number of candidates vying for attention in ever-more challenging circumstances? Another question relates to the role of individual users of systems approaches and the influences that they can bring to bear on contributing towards developing systems approaches.

Perspective 4: Groupings of Systems Thinkers (Magnus Ramage and Karen Shipp)

The question regarding the contextual influence of individual systems practitioners is one addressed in the fourth perspective presented here. In *Systems Thinkers* (Ramage and Shipp 2009 [2020]) the authors uniquely focus on the life and work of individuals behind the systems approaches rather than the systems approaches themselves. It is perhaps for this reason that their demarcation of systems approaches using the diagram below might be even more controversial. The prime intent behind this typology as acknowledged by the authors is to provide a foothold for the readers' engagement with the 30 systems thinkers covered:

> We had arguments with colleagues about the idea of providing any sort of 'map' of the territory. Of course there is no 'true' map – an individual might lay out the connections between these authors in any number of ways, to reveal a different pattern. By providing a model we emphasise certain connections, but underplay others. Yet to offer no map at all – no structure – is to deny the explorer a vital aid to their journey. Without some sort of map, the learner cannot even start to lay down the interconnections in memory. This map, which over time they will refine, extend, amend, embellish, and colour with their own experiences, preferences and insights, can only ever be an approximation, a starting point from which the individual can set out. (ibid, Afterward, p. 309)

Figure 1.3 illustrates the seven groupings: early cybernetics, general systems theory, system dynamics, soft and critical systems, later cybernetics, complexity theory, and learning systems.

As the authors suggest, the perspective here is unconventional and provocative, but was made with the intention of privileging the individuals rather than some abstract notion of either *systems* approaches (schools of thought) or perceived *situations* of interest: "The groupings were created from the starting point of our chosen authors rather than schools of thought, and thus they do not represent a comprehensive guide to a particular school of thought (for example, there are many more thinkers who have contributed to general systems theory than the four we cover)" (ibid).

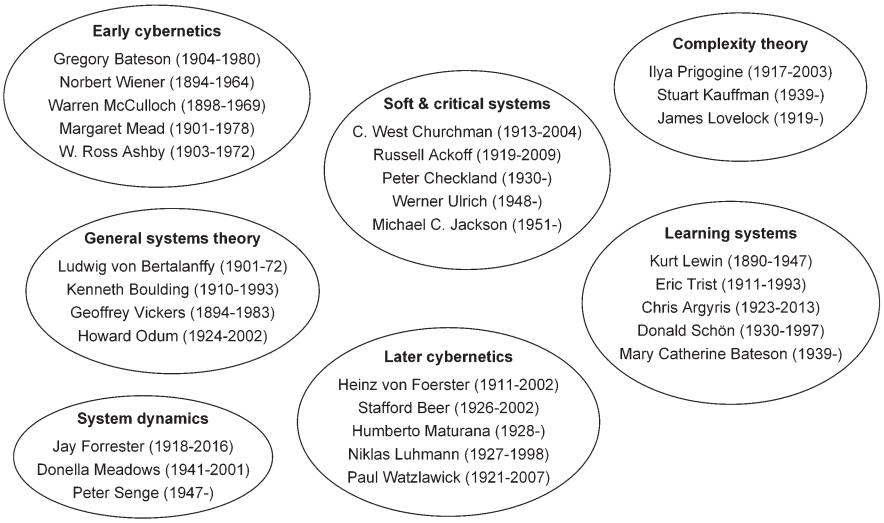

Fig. 1.3 The authors and groupings in Systems Thinkers (Ramage and Shipp 2009 [2020])

A few other difficulties might be mentioned. For example, the grouping of soft and critical systems thinking together may cause some discomfort amongst traditional advocates of critical systems thinking who may prefer to hold on to a clear boundary of demarcation. Similarly the grouping of early (first order) and later (second order) cybernetics may appear to mask a very distinctive traditional divide. However, the refreshing and appealing aspect is that the authors are very explicit about this being their own particular take on systems approaches. It is derived from a thorough reading around the personal circumstances and interrelationships of the systems authors in their context of practice. It raises questions regarding the role and circumstances of *people* in the development of practice.

There is a paradox here in any attempt at typography. Attempts to categorize tend to de-emphasise links and ultimately break links, which arguably is the very problem that gave rise to contemporary systems thinking in the first place. So what perspective on systems approaches have we taken as editors of this reader? Moreover, what is the rationale behind selecting just five systems approaches?

1.4 Systems Thinking in Practice

1.4.1 Systems Approaches in Practice: Our Own Perspective

These four perspectives are all helpful in generating an understanding about how different systems approaches may be related to each other and to other schools of thought and practice, and also how they may be related to the situations in which

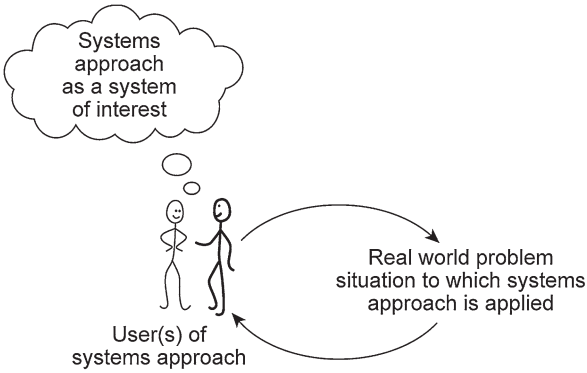

Fig. 1.4 Three aspects of using a systems approach: situation, user and system

they could be used. The five systems approaches presented in this reader have been chosen because they each demonstrate a rich interplay between the situation, the practitioner community, and the approach itself. This interplay has generated a convincing and real sense of robustness and vigour for each approach. A second reason for selecting these particular five approaches relates to the different ways in which they take account of three motivations for the use of a systems approach in any systems intervention, namely: understanding interrelationships, dealing with different perspectives, and addressing power relations. All five approaches address each purpose in different ways and to a greater or lesser extent.

Peter Checkland identified three recurring attributes or entities relating to any intervention (Checkland 2000)[1]: the context of use, the user and the methodical approach being used. The four perspectives outlined above provide different emphases on these three recurring themes:

1. The perceived problem *situation* (particularly Perspectives 2 and 3)
2. The *users* of the systems approach (including local people participating in the intervention and the practitioner community who lead such interventions) in the context of use (particularly Perspectives 2 and 4)
3. The 'methodology' or *systems* approach itself (particularly Perspectives 1 and 3)

It is the interplay between these three attributes that determine the effectiveness of any approach to intervention. Fig. 1.4 illustrates the dynamics of these attributes.[2]

The approaches described in this book have each been internationally applied, in a wide and diverse range of contexts by diverse sets of practitioners. They are used in several languages and in countries with very different traditions of thinking. They can be applied over different time-scales – some studies are done in 10–15 min whilst others may take several years. They are also used in different domains of activity including organisational change, information systems strategy and develop-

[1] Originally sequenced by Checkland as (1) methodology, (2) users, and (3) situation. Re-sequenced for our purposes.

[2] Later as Fig. 7.5 in the Epilogue, this mental model is further developed towards a systems thinking in practice heuristic.

ment, environmental planning, international development, business strategy, etc. In short, they each embody a rich inheritance from practice.

The practices also have strong theoretical underpinnings which contribute both to their robustness and credibility amongst practitioners from different traditions. But perhaps the strongest attribute shared by these five approaches is their adaptability to change and modification. They have each proved resilient and adaptable given the challenges of different problem situations, involving different sets of users, bringing along different traditions of practice involving other conceptual approaches conventionally used for improving situations. Their value resides in their capacity to connect to a variety of professional traditions and schools of thought of different origins ranging from village-based participatory development initiatives in less-developed countries to multinational corporate enterprises and government.

1.4.2 Towards Purposeful Systems Thinking in Practice

All five approaches in this book treat systems as social constructs. There is variation amongst them as to how much emphasis is put on the imperatives of *thinking about systems* as real world ontological entities, and *systems thinking* using systems more explicitly as epistemological constructs (see Fig. 1.1). Crudely, we might associate SD and VSM with the tradition of *thinking about systems* and SODA, SSM, and CSH with the tradition of *systems thinking*, though in practice there is considerable variability amongst individual practitioners.

But whether we consider systems as real world entities or not, we are reminded that *any* systems approach involving the conceptualization of systems might be characterized as serving some purpose (cf. Churchman 1968). We are also reminded by Churchman that purposeful intervention (where purposes can change and develop in the course of intervention) is preferable to purposive intervention (where purposes remain fixed). Drawing on Perspective 1 above, and a particular view of the *interrelatedness* between Habermas' three constitutive interests – technical, practical, and emancipatory – (Reynolds 2002) we suggest that any systems approach to intervention fulfils three generalised interrelated *purposes*. In serving these three purposes in an interrelated way, the input to intervention becomes purposeful (subject to change and modification). The outcome of purposeful intervention is systemic change. The three generalized purposeful orientations can be listed.

1. *Purposeful orientation 1*: Making sense of, or simplifying (in *understanding*), relationships between different entities associated with a complex situation. Notwithstanding the roots of some systems approaches in traditions of systems science, all systems approaches explored in this collection arguably present systems more as an 'art' form rather than as a 'science'. The prime intention is not to get some thorough comprehensive knowledge of situations, but rather to acquire a better understanding in order to improve the situation.

2. *Purposeful orientation 2*: Surfacing and engaging (through *practice*) contrasting perspectives associated with complex situations. The success of any systems approach discussed in these pages is ultimately dependent on the user, applying the ideas in a particular context rather than something inherent in a description of the approach. Whilst we may discuss different approaches in an abstract sense, any claims towards their value in creating beneficial change in a situation is dependent on the context of use, the purpose for which it is employed, and the skill and imagination of the practitioner.
3. *Purposeful orientation 3*: Exploring and reconciling (with *responsibility*) power relations, boundary issues and potential conflict amongst different entities and/or perspectives. The aim here is not to provide yet another ready-to-hand matrix to offer clients through a consultancy, but rather to gently disrupt, unsettle and thereby provoke new systems thinking.

The five systems approaches are chosen for their particular strengths in serving one purpose to a greater extent over the other two purposes. So SD and VSM might be considered as having a primary strength and focus on making sense of interrelatedness and interdependencies between entities in a situation. For SSM and cognitive mapping associated with SODA, the primary strength and focus is on surfacing and engaging with different perspectives. CSH prompts particular attention to reflective practice and the need to address issues of power implied though our boundary judgements.

These particular strengths are an attribute of the historic roots of each approach. They do not signal a prescribed way of using the approach. Individual users of SD and VSM may for example experience a value in using the approaches as primary means of engaging with different perspectives and/or power relations. Likewise, users of SSM and SODA may in particular circumstances value its use in understanding interrelationships and interdependencies, or with engaging different boundary judgements. Users of CSH can sometimes attach more importance to understanding interrelationships and interdependencies, and/or engaging with multiple perspectives, again depending on the situation or context of use by individual users. Our rationale for choosing these five approaches is based not upon a prescriptive idea of 'best' *practice*, but rather upon an *understanding* of their particular pedigree – including (a) the experiences of interplay between the approaches themselves, communities of practitioners, and the situations in which they are used, and (b) the original dominant purpose to which they served. It is up to you, the reader (and user), to determine the further value of each approach in the context of your own traditions of practice, amongst your own communities of practitioners, and with respect to improving whatever situations of interest you are engaged with (Reynolds et al. 2017).

1.5 Five Approaches Described

System Dynamics (SD) Authored by John Morecroft

System dynamics was founded in the late 1950s by Jay W. Forrester of the MIT Sloan School of Management with the establishment of the MIT System Dynamics Group (Forrester 1961). At that time, he began applying what he had learned about systems during his work in electrical engineering to everyday kinds of systems. It is an approach to understanding the behaviour of complex systems over time. It deals with internal feedback loops and time delays that affect the behaviour of the entire system. What makes using system dynamics different from other approaches to studying complex systems is the use of feedback loops and stocks and flows in displaying nonlinearity. Forrester started work on servo-mechanism devices to control radar in the late 1950s, and then significantly moved into the field of, first, industrial relations, and later modelling global resource depletion, both of which involved Forrester himself (Forrester 1971). Sustainable development involved modelling of 'world systems'; work complemented significantly through sponsorship by the influential Club of Rome (Meadows et al. 1972, 1992). System dynamics later provided the crux of the systems approach advocated as the *Fifth Discipline* in the celebrated book of the same title authored by Senge (1990). This softer qualitative use of system dynamics modelling, as a means of progressing more meaningful conversation on complex issues, has developed in tandem with more advanced quantitative modelling (Kunc 2018).

Viable System Model (VSM) Authored by Patrick Hoverstadt

The VSM is a model of the necessary and sufficient conditions for the viability of systems. A viable system is a system able to keep an independent existence. To do so it needs to be organised in such a way as to meet the demands of surviving in a changing environment. One of the prime features of systems that survive is that they are adaptable. The model itself was developed by the cybernetician Stafford in several publications, mainly *Brain of the Firm* (Beer 1972) and *Heart of Enterprise* (Beer 1979) for the theory, and *Diagnosing the System* (Beer 1985) for the methodology required for application. Beer's ideas arose out of a synthesis of Eastern and Western thought. His time in India as a very young man and subsequently his interest in Eastern thought, particularly Indian cultural traditions, was a very important factor in the emergence of the VSM. Beer's own engagement with practicing VSM was most notably carried out under invitation to Allende's Chile in the early 1970s before the military coup. Beer effectively founded management cybernetics – now known as Organisational Cybernetics – which is being developed and used extensively by cyberneticians worldwide. VSM, like SD and each of the other approaches in this compilation, has been and is continually being moulded for a variety of different levels of contexts including contexts with disparate purposes (Hoverstadt and Loh 2017). Aside from different organisational fields, it has been used in contexts ranging from promoting efficiency in small organizations and communities to guid-

ing major environmental policy at national and regional levels (cf. Espejo 1990; Espinosa et al. 2008).

Strategic Options Development and Analysis (SODA, with Cognitive Mapping) Authored by Fran Ackermann and Colin Eden

Cognitive mapping is a technique for revealing and actively shaping the mental models, or belief systems (mind maps, cognitive models) that people use to perceive, contextualize, simplify, and make sense of otherwise complex problems. SODA was built on Colin Eden's interest during the 1970s in Kelly's psychological work on 'personal construct theory' (Kelly 1955). The notion of cognitive mapping is based upon a process of meaning construction to facilitate negotiation and arrival at some agreed plans of action. Whilst being appropriate at the individual level in clarifying thoughts around a particular issue, work on SODA encompasses much wider contexts of *strategic* thinking; neatly encapsulated through the software acronym JOURNEY making (JOintly Understanding Reflecting and NEgotiating strategY). SODA is the methodology used for cultivating organisational change through attention to and valuing of individual perspectives in a concerted manner. The importance of facilitation (process) skills in consultancy practice is thereby emphasised in tandem with conventional knowledge management (content) skills. The techniques are used in developing strategies for improvement based on three hierarchical systems levels: (a) goals (cf. ideal planning); (b) strategic directions (cf. objective planning); and (c) potential options (cf. operational planning). The two key source publications for SODA are *Making Strategy: Journey of Strategic Management* by (Eden and Ackermann 1988) and *The Practice of Making Strategy: A Step by Step Guide* (Ackermann et al. 2005). As noted in these publications, the context of their application has varied from dealing with individual decision making to small and large enterprises. Cognitive mapping has also been recommended and used for dealing with wider international inter-organisational dilemmas (Hewitt and Robinson 2000: Castaño et al. 2017).

Soft Systems Methodology (SSM) Authored by Peter Checkland and John Poulter

SSM is an approach to organisational process modelling. It was developed by Peter Checkland and colleagues at the University of Lancaster Systems Department through a 20 year program of action research (Checkland 2019). The primary use of SSM is in the analysis of complex situations where there are divergent views about the definition of the problem — 'soft problems' (e.g. How to improve health services delivery; How to manage disaster planning; When should mentally disordered offenders be diverted from custody? What to do about homelessness amongst young people?). In such situations even the actual problem to be addressed may not be easy to agree. To intervene in such situations the soft systems approach uses the notion of a 'system' as an interrogative device that will enable debate amongst concerned parties. The major texts on SSM are: *Systems Thinking, Systems Practice* (Checkland 1981) *Soft Systems Methodology in Action* (Checkland and Scholes 1990); *and Information, Systems and Information Systems* (Checkland and Holwell 1998). The most recent book, *Learning for Action* (Checkland and Poulter 2006) is

a ‘a short definitive account of SSM and its use’ provides the source material for this compilation. SSM has been used to examine organisational change in large multinational corporations, with several hundred participants in the study; it can be used by an individual to manage, for example, personal recovery from substance abuse; it has been used to research Inuit fishing in Labrador; by an NGO volunteer to engage local people in mine clearance after war in the Middle East; by members of a women’s forum in Japan to make sense of the impacts of societal changes on their lives; by consultants working on information systems planning in the NHS – these are just some of the areas in which SSM has been applied.

Critical Systems Heuristics (CSH) with Boundary Critique Authored by Werner Ulrich and Martin Reynolds

Critical systems heuristics represents the first systematic attempt at providing both a philosophical foundation and a practical framework for critical systems thinking. CSH is a framework for reflective practice based on practical philosophy and systems thinking, developed originally by Werner Ulrich. The basic idea of CSH is to support boundary critique – a systematic effort of handling boundary judgments critically. Boundary judgments determine which empirical observations and value considerations count as relevant and which others are left out or are considered less important. Because they condition both ‘facts’ and ‘values’, boundary judgments play an essential role when it comes to assessing the meaning and merits of a claim. *Critical heuristics of social planning: a new approach to practical philosophy* (Ulrich 1983) is the principle text on this approach. CSH like SSM emerged from an ethical systems tradition promoted through the works of the American systems philosopher C. West Churchman. Werner Ulrich’s own work in developing CSH as a means of supporting social planning was rooted in traditions of Churchman’s systems philosophy (particularly Churchman 1971, 1979) along with American philosophical pragmatism and European critical social theory. Whilst the CSH case studies described in this compilation are rooted in environmental management, CSH has been deployed in a wide range of significant contexts ranging from health care planning, city and regional planning, and energy and transportation planning (Ulrich 1987, p. 276), enhancing prison service support (Flood and Jackson 1991b), towards promoting an alternative lens for corporate responsibility (Reynolds 2008a) and informing international development initiatives (McIntyre-Mills 2004; Reynolds 2008b; Stephens et al. 2018).

1.6 Framing the Chapters

The core chapters in this compilation are summarized contemporary versions of the five approaches. For ease of comparison, each chapter is based on a template comprising three substantive parts:

(i) *Description of whole approach in broad terms*: what it is (nature/ essence of method); and what it looks like (basic characteristics/ attributes)

(ii) *Detailed descriptor of the parts*: how it works (tools, concepts) together with the basic techniques, procedures and traps. In fulfilling the mission to be 'A Practical Guide', this part comprises most of the sections in the chapter providing guidance on practising the systems approach
(iii) *Descriptor of whole approach in context of use*: why it is significant; a retrospective review of the rules of skilled practice in the application of the approach. What are the minimum claims that might be made on the use of the approach by a skilled practitioner?

Whilst the restricted space does not allow detailed expositions of the theoretical underpinnings of each approach, we trust that the reader will gain an appreciation of both theoretical foundations and practice. The experiences provided in these pages cannot possibly encompass the whole user experience, let alone all users' experiences over the past decades. Additional experiences of the use of tools from these approaches might be sought from the many readings associated with each approach. But no experiences are more valuable than your own. The approaches described here are not suggested replacements for your own skills, but rather sources for enhancing your skills for managing complex situations and making purposeful change for the better.

References

Ackermann, F., Eden, C., & Brown, I. (2005). *The practice of making strategy*. London: Sage.
Ackoff, R. (1974). *Redesigning the future: A systems approach to societal problems*. New York: John Wiley.
Ackoff, R. (1981). *Creating the corporate future: Plan or be planned for*. New York: John Wiley.
Ashby, W. R. (1956). *An introduction to cybernetics*. London: Chapman & Hall.
Bateson, G. (1972). *Steps to an ecology of mind*. Toronto: Ballantine.
Bawden, R. J. (1998). The community challenge: The learning response. *New Horizons (Journal of the World Education Foundation Australia), 99*(October), 40–59.
Beer, S. (1972). *Brain of the firm*. London/New York: John Wiley.
Beer, S. (1979). *The heart of enterprise*. London/New York: John Wiley.
Beer, S. (1985). *Diagnosing the system for organizations*. London/New York: John Wiley.
Bertalanfy, L. V. (1956). General systems theory. *General Systems Yearbook, 1*, 1–10.
Cabrera, D., Colosi, L., & Lobdell, C. (2008). Systems thinking. *Journal of Evaluation and Program Planning, 31*(3), 317–321.
Castaño, J. M., van Amstel, F., Hartmann, T., & Dewulf, G. (2017). Making dilemmas explicit through the use of a cognitive mapping collaboration tool. *Futures, 87*, 37–49.
Chapman, J. (2004). *System failure: Why governments must learn to think differently*. London: Demos.
Checkland, P. B. (1972). Towards a systems-based methodology for real world problem solving. *Journal of Systems Engineering, 3*(2), 87–116.
Checkland, P. (1978). The origins and nature of 'hard' systems thinking. *Journal of Applied Systems Analysis, 5*, 99–110.
Checkland, P. (1981). *Systems thinking systems practice*. Chichester: John Wiley.
Checkland, P. (2000). Peter Checkland at 70: A review of soft systems thinking. *Systems Research and Behavioural Science, 17*(1), 11–58.

Checkland, P. (2019). Reflections on 40 years in the management field: A Parthian shot (friendly). *Journal of the Operational Research Society, 70*(8), 1219–1223. https://doi.org/10.1080/01605682.2019.1590137.

Checkland, P., & Holwell, S. (1998). *Information, systems and information systems*. Chichester: John Wiley.

Checkland, P., & Poulter, J. (2006). *Learning for action: A short definitive account of soft systems methodology, and its use practitioners, teachers and students*. Chichester: John Wiley.

Checkland, P., & Scholes, J. (1990). *Soft systems methodology in action*. Chichester: John Wiley.

Churchman, C. W. (1968). *The systems approach*. New York: Dell.

Churchman, C. W. (1971). *The design of inquiring systems: Basic concepts of systems and organizations*. New York: Basic Books.

Churchman, C. W. (1979). *The systems approach and its enemies*. New York: Basic Books.

Churchman, C. W., Ackoff, R., et al. (1957). *Introduction to operations research*. New York: John Wiley.

Eden, C. (1988). Cognitive mapping: A review. *European Journal of Operational Research, 36*, 1–13.

Eden, C., & Ackermann, F. (1988). *Making strategy: The journey of strategic management*. London: Sage.

Espejo, R. (1990 guest editor). "The Viable Systems Model." *Systems Practice (special edition on VSM)* 3(3).

Espinosa, A., Harden, R., et al. (2008). A complexity approach to sustainability – Stafford Beer revisited. *European Journal of Operational Research, 187*, 636–651.

Flood, R. L. (1990). Liberating systems theory: Towards critical systems thinking. *Human Relations, 43*, 49–75.

Flood, R. L., & Jackson, M. C. (1991a). Total systems intervention: A practical face to critical systems thinking. In R. L. Flood & M. C. Jackson (Eds.), *Critical systems thinking*. Chichester: John Wiley.

Flood, R. L., & Jackson, M. C. (1991b). Critical systems heuristics: Application of an emancipatory approach for police strategy towards carrying offensive weapons. *Systems Practice, 4*(4), 283–302.

Forrester, J. W. (1961). *Industrial dynamics*. Cambridge, MA: Wright-Allen Press.

Forrester, J. W. (1971). *World dynamics*. Cambridge, MA: Wright & Allen.

François, C. (Ed.). (1997). *International Encyclopaedia of systems and cybernetics*. München: K. G. Saur Publishing.

Fuenmayor, R. (1991). Between systems thinking and systems practice. In R. L. Flood & M. C. Jackson (Eds.), *Critical systems thinking: Directed readings*. Chichester: John Wiley.

Habermas, J. (1972). *Knowledge and human interests*. London: Heinemann.

Habermas, J. (1984). *The theory of communicative action volumes 1 and 2*. Cambridge: Polity Press.

Hall, A. D. (1962). *A methodology for systems engineering*. New York: Van Nostrand.

Hewitt and Robinson. (2000). Putting inter-organizational ideas into practice. In D. Robinson, T. Hewitt, & J. Harris (Eds.), *Managing development: Understanding inter-organizational relationships* (pp. 301–328). London: Sage.

Hoverstadt, P., & Loh, L. (2017). *Patterns of strategy*. Abingdon: Routledge.

Jackson, M. (1982). The nature of soft systems thinking: The work of Churchman, Ackoff and Checkland. *Journal of Applied Systems Analysis, 9*, 17–28.

Jackson, M. (1990). Beyond a system of systems methodologies. *Journal of the Operational Research Society, 41*(8), 657–668.

Jackson, M. (2000). *Systems approaches to management*. New York: Kluwer Academic/Plenum Publishers.

Kelly, G. A. (1955). *The psychology of personal constructs. Volume one: A theory of personality*. New York: W.W. Norton.

Kunc, M. (Ed.). (2018). *System dynamics – Soft and hard operational research*, in the OR Essentials book series, Palgrave Macmillan.

Maiteny, P., & Ison, R. (2000). Appreciating systems: Critical reflections on the changing nature of systems as a discipline in a systems-learning society. *Systemic Practice and Action Research, 13*(4), 559–586.

Mason, R. O., & Mitroff, I. I. (1981). *Challenging strategic planning assumptions: Theory, cases and techniques*. New York: John Wiley.

McIntyre-Mills, J. (2004). *Critical systemic praxis for social and environmental justice: Participatory policy design and governance for a global age*. New York: Kluwer Academic/ Plenum Publishers.

Meadows, D. H., et al. (1972). *The limits to growth: A report for the Club of Rome's project on the predicament of mankind*. London: Earthscan.

Meadows, D. H., et al. (1992). *Beyond the limits of growth*. Chelsea Green: Post Mills.

Midgley, G. (2000). *Systemic intervention: Philosophy, methodology and practice*. New York: Kluwer/Plenum.

Midgley, G. (Ed.). (2003). *Systems thinking (4 vols)*. London: Sage.

Optner, S. L. (1965). *Systems analysis for business & industrial problem solving*. New York: Prentice-Hall.

Ramage, M., & Shipp, K. (2009 [2020]). *Systems thinkers* [2nd ed.]. London: Springer.

Reynolds, M. (2002). Defence of knowledge constitutive interests: A comment on 'what is this thing called CST?' (Midgely, 1996). *Journal of the Operational Research Society, 53*(10), 1162–1165.

Reynolds, M. (2008a). Getting a grip: Critical systems for corporate responsibility. *Systems Research and Behavioral Science, 25*(3), 383–395.

Reynolds, M. (2008b). Reframing expert support for development management. *Journal of International Development, 20*(6), 768–782.

Reynolds, M. (2015). Communicating about systems and complexity: From contingency to praxis. In M. Q. Patton (Ed.), *Gedenkschrift to honor Brenda Zimmerman's contributions to understanding complexity and social innovation* (pp. 32–36). Canada: Social Innovation Generation de L'innovation sociale.

Reynolds, M., Blackmore, C., Ison, R., Shah, R., & Wedlock, E. (2017). The role of systems thinking in the practice of implementing sustainable development goals. In L. F. Walter (Ed.), *Handbook of Sustainability Science and Research* (pp. 677–698). London: Springer.

Senge, P. (1990). *The fifth discipline*. New York: Currency Doubleday.

Stephens, A., Lewis, E. D., & Reddy, S. (2018). Towards an inclusive systemic evaluation for the SDGs: Gender equality, environments and marginalized voices (GEMs). *Evaluation, 24*(2), 220–236.

Trist, E. L., Higgin, G. W., Murray, H., & Pollock, A. B. (1963). *Organisational choice*. London: Tavistock.

Ulrich, W. (1983). *Critical Heuristics of social planning: A new approach to practical philosophy*. Bern: Haupt; paperback reprint edition, Chichester: Wiley (same pagination).

Ulrich, W. (1987). Critical heuristics of social systems design. *European Journal of Operational Research, 31*(3), 276–283.