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# 1. Introducing the roots, evolution and effectiveness of sustainability assessment

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## 1.1 INTRODUCTION

Sustainability assessment can be simply defined as any process that directs decision making towards sustainability (Bond and Morrison-Saunders, 2011, derived from Hacking and Guthrie, 2008). This definition is sufficiently broad to encompass a vast range of decision making, from choices of individuals in everyday life through to projects, plans, programmes or policies more familiarly addressed in the fields of impact assessment. The variety of processes and applications under the banner of ‘sustainability assessment’ became evident through a search for the term in January 2012 on the Scopus database, which showed that growth in publications on sustainability assessment has been exponential in the period 1994 to 2010 inclusive (Bond et al., 2012). It found examples of sustainability assessment practice from fields including engineering, agriculture and planning, many of which relate to very specific one-off decisions and are outside the bounds of traditional impact assessment, defined as ‘the process of identifying the future consequences of a current or proposed action’ (International Association for Impact Assessment, 2009).

Based on this background understanding of sustainability assessment, this chapter sets the context for, and introduces, the remainder of this book. It begins by explaining how decision making first came to be recognised as a cause of environmental problems, culminating in the need for some kind of *ex ante* understanding of decision implications. It then goes on to look at the process that gradually led to the development of an approach which we can call ‘sustainability assessment’. It goes on to consider the effectiveness of sustainability assessment; that is, now that a tool exists, how do we know it works and delivers what is expected of it? Thus the chapter tells the story of where sustainability assessment came from, how it changed as it evolved, and what we currently understand about the way it works and what it can deliver.

After this background is provided, the structure of the book itself is introduced. As one of the series of *Handbooks* on impact assessment, this book presents some of the latest research on sustainability assessment emerging from different parts of the world. The chapters reflect the variety of this research, with some chapters focusing on important conceptualisations relevant to sustainability assessment, while others focus on practical applications of sustainability assessment at different scales and in different sectors. As with other forms of impact assessment, sustainability assessment draws on (and can embed) different tools and techniques, and several chapters explore tools that are particularly useful in addressing the challenges inherent to the practice of sustainability assessment. Still other chapters reflect on the role of sustainability assessment in decision processes.

## 1.2 THE JOURNEY FROM ENVIRONMENTAL DEGRADATION TO ENVIRONMENTAL CONSERVATION TO SUSTAINABLE DEVELOPMENT

The history of *ex ante* interventions to achieve environmental conservation outcomes can be traced back to the early part of the twentieth century, when environmental disasters started to be recognised as having anthropogenic causes in the United States, one example being the Dust Bowl of the USA's Great Plains in the 1930s. However, it wasn't until the 1960s that the paradox of the government being both custodian of the environment and facilitator of development was recognised, leading to questions about government emphasis and a shift back towards the environment. Prominent publications in this movement included *Silent Spring* by Rachel Carson (1963), linking environmental hazards and personal health, and *The Limits to Growth*, produced for the Club of Rome (Meadows et al., 1972).

This new awareness of the environment culminated in the production of a congressional white paper containing possible elements of a national policy on the environment. On its passage through Congress, this bill was modified several times to resolve conflicts with other bills and to make certain compromises. It was passed by the Senate on 20 December 1969, and by the House of Representatives on 23 December 1969, and thus became the National Environment Policy Act (NEPA) 1969. President Richard Nixon signed NEPA on 1 January 1970, when it became law, and accompanied it with a statement 'proclaiming the 1970s as the "decade of the environment"' (Karkkainen, 2007, p. 47).

The appearance of environmental impact assessment (EIA) through the enactment of NEPA (1969) in the United States of America is well documented. Its importance in terms of the development of impact assessment as a decision-support tool of choice is also well understood, with Canter (1996, p. xvii) stating that '(NEPA) in the United States is considered to be the seminal legislation for the environmental impact assessment (EIA) process in the majority of some 100 countries that have adopted EIA legislation'. We now know that EIA exists as a requirement in all countries in the world bar two (as at 2011) (Morgan, 2012).

EIA is a term which is usually reserved for application to projects, as opposed to plans, programmes and policies. Indeed in many countries separate strategic environmental assessment (SEA) legislation has been adopted which applies to plans and programmes, for example the European Union SEA Directive (European Parliament and the Council of the European Union, 2001), and sometimes policies also. This distinction in terms of application to different levels of decision making was never enshrined in NEPA 1969, which in theory should apply to all levels of decision making. However, as Clark et al. (2011) report, programmatic EIA (the term used for strategic environmental assessment in the USA) 'has been underused in NEPA applications' (Clark et al., 2011, p. 74).

NEPA is vaguely worded (Glasson et al., 2012), which has left a lot of room for interpretation by the courts and also by the Council on Environmental Quality, which formulates associated guidelines. Other examples of EIA legislation have been more specific about the definition of the environment, at least in terms of the environmental components that fit within the scope of 'environment' – although this definition changes

over time. For example, in 1985 the definition of the environment in the EU Directive on EIA (Council of the European Communities, 1985, Article 3) was:

- human beings, fauna and flora,
- soil, water, air, climate and the landscape,
- the inter-action between the factors mentioned in the first and second indents,
- material assets and the cultural heritage.

However, by 2014 (European Parliament and the Council of the European Union, 2014), this had changed to:

- (a) population and human health;
- (b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;
- (c) land, soil, water, air and climate;
- (d) material assets, cultural heritage and the landscape;
- (e) the interaction between the factors referred to in points (a) to (d).

The UN Conference on the Human Environment held in Stockholm in 1982 was a response to increasing concerns over the state of the global environment and led to the development of the United Nations Environment Programme (UNEP) – and so, more than a decade since EIA appeared, the recognition that the human impacts on the environment continued to cause concern was clear. However, during the 1980s, political rhetoric shifted from a focus on environmental protection to one of sustainable development; there was significant advocacy at that time for the facilitation of development, with some anxiety that environmental protectionism was detrimental to a pro-development stance (Garner and O’Riordan, 1982).

The story of the advent of sustainable development as a globally agreed goal is well described by O’Riordan (2000). The UN established the World Commission on Environment and Development in 1983 with the specific task of ‘identifying and promoting the cause of sustainable development’ (O’Riordan, 2000, p.41). It reported in 1987, giving us the most commonly quoted definition of sustainable development as ‘development that meets the needs of current generations without compromising the ability of future generations to meet their needs’ (World Commission on Environment and Development, 1987, p.8). George (1999, p.178) interprets this definition as being equity focused, with the twin pillars of sustainable development being ‘intergenerational equity – a necessary condition for sustainability’ and ‘intragenerational equity – a necessary condition for development’.

O’Riordan (2000, p.41) draws attention to the ‘distinction between interventionist and nurturing modes, as captured in the language adopted, in general, by the economic ministries on the one hand and the environmental ministries on the other’ as sustainable development gained political traction around the world, the salient point being that sustainable development can be interpreted to have a meaning which fits in with the majority of existing agendas. The distinction highlighted by O’Riordan can be considered the basis for disagreement which exists in the literature over the meaning of the terms ‘sustainability’ and ‘sustainable development’ (see, for example, Lélé, 1991); the former derives from a carrying capacity stance and owes its roots to ecological sustainability considerations, whilst the latter derives from economic imperatives to develop, albeit

within limits. However, the two terms are also used interchangeably and, specifically in the context of sustainability assessment where the goal is to direct decision making towards sustainability, the two terms are regarded as synonymous, in line with Bond and Morrison-Saunders (2013), and are used as such throughout the remainder of this book.

The Rio Earth Summit in 1992 was the political driver that led to the adoption of sustainable development as a national goal across the globe. Pursuit of sustainable development was formalised in the five-year review of the Earth Summit, which committed governments to formulate national strategies for sustainable development (Ayre and Callway, 2005). Some examples of sustainable development strategies that owe their existence to this chain of events include those of the United Kingdom (HM Government, 2005), the European Union (Council of the European Union, 2006) and the National Strategy for Ecologically Sustainable Development in Australia (Ecologically Sustainable Development Steering Committee, 1992). Sustainable development can thus be considered the currently dominant rhetorical device underpinning government actions (Adger et al., 2003) and the stated goal for a variety of policies in countries across the world.

### 1.3 THE IMPLICATIONS OF SUSTAINABLE DEVELOPMENT FOR ENVIRONMENTAL ASSESSMENT

What is the role, then, for EIA within the sustainability agenda, or for SEA, which examines the implication of more strategic actions (some combination of policies, plans and programmes, depending on the specific legislative requirements) and is also now widespread (Fundingsland Tetlow and Hanusch, 2012)? Given the combination of the new global goal of sustainable development and an existing tool focused on environmental protection (EIA), it would seem inevitable that a new tool, sustainability assessment, would be embraced and would replace both EIA and SEA. To a small extent that has happened, and may still be occurring, as there is increasing evidence of sustainability assessment practice (Bond et al., 2012), but there are other interpretations of how best to manage this change:

1. There are arguments that decision making already incorporates socio-economic issues and that it was environmental consequences that were missing – thus the environmental advocacy role of EIA (and SEA) is being eroded and socio-economic issues ‘double-counted’ in sustainability assessment (Morrison-Saunders and Fischer, 2006).
2. There is an existing ‘industry’ of EIA and SEA which is, to an extent, self-sustaining to protect the interests of those who now make a living through the process (Bond, 2003). That is, EIA is entrenched practice which is difficult to change.
3. Arguments are also made that EIA and/or SEA already have sustainable development as their aim (Sheate, 2009). A case in point is the EU SEA Directive, which the authors specifically argue has sustainability goals (Feldmann et al., 2001). Arguments have also been made that the text of NEPA (1969) is closely aligned with sustainable development (e.g. Bond et al., 2010).

So the context for impact assessment practice is complex. There is evidence of a proliferation of types of impact assessment, with Morrison-Saunders et al. (2014) listing over 40 and acknowledging this is a subset of the true figure. A number of these processes share a common goal of sustainable development, although this is a very plural term, as Chapter 2 by Pope et al. will go on to demonstrate. Hacking and Guthrie (2008) identified a series of different forms of impact assessment which had been specifically developed to deliver sustainable development, which are described in Chapter 2. Based on their analysis a traditional EIA process would come out as being biophysically focused, rather than comprehensive, separate rather than integrated, and project specific rather than strategic. An ideal form of sustainability assessment would, on the other hand, be expected to be comprehensive, spanning all pillars of sustainability, fully connected in terms of the techniques used and themes covered, and very forward looking. On this basis it can be seen that arguing that an existing EIA process has sustainability goals, without substantive changes to the procedure, might fall short of what might be expected for an effective process for directing decision making toward sustainability.

This brings us on to the next topic of the chapter, which addresses the question ‘Just what do we mean by effectiveness?’ Section 1.4 explores this question in the context of sustainability assessment.

## 1.4 SUSTAINABILITY ASSESSMENT EFFECTIVENESS

The remainder of this book will highlight the significant diversity in the way sustainability assessment is, and can be, operated in a large number of different decision contexts. This diversity ultimately means that no single, definitive and globally agreed sustainability assessment process is likely to emerge beyond some basic steps which most researchers can agree are likely to be required (Morrison-Saunders and Pope, 2013b, p. 56):

- Step 1: decision to conduct a sustainability assessment (screening);
- Step 2: identification of the desired outcome and hence the sustainability assessment decision question to be addressed;
- Step 3: establishment of sustainability goals and criteria for the decision (scoping);
- Step 4: identification of alternatives and options to achieve the desired outcome;
- Step 5: prediction and evaluation of the impact of each alternative;
- Step 6: selection and enhancement of the preferred alternative (mitigation);
- Step 7: approval decision and announcement;
- Step 8: implementation and monitoring (follow-up).

These steps are similar to any generic impact assessment steps (see, for example, Glasson et al., 2012 for the basic EIA steps), but the opportunity for different requirements and practice within such a generic framework is vast. This means that generic guidance, applicable in different contexts, on the ‘right’ way to approach sustainability assessment is impossible to formulate. And, without any common agreement on what sustainability assessment should look like, assessing effectiveness is inevitably tricky. Despite this, effectiveness can be unpicked and conceptualised in the context of sustainability assessment,

and this section aims to do just that. Developing some idea of how effectiveness might be evaluated will provide valuable context for reading the rest of this book.

Bond et al. (2013) have developed a framework for evaluating the effectiveness of sustainability assessment. This draws on decades of research examining environmental decision making which has tended to argue that the original theoretical basis for EIA (the forerunner of all other impact assessment processes in use today), that better information will lead to better decisions, is overly simplistic and flawed (see, for example, Bartlett and Kurian, 1999; Cashmore et al., 2004). Their effectiveness framework looks at the ability of the sustainability assessment process to deliver on several criteria. These criteria reflect six categories of effectiveness: procedural; substantive; transactive; normative; knowledge and learning; and pluralism (Bond et al., 2013), which are briefly outlined in Table 1.1.

*Table 1.1 Categories of effectiveness for impact assessment processes*

Effectiveness category	Effectiveness question
Procedural effectiveness	Have appropriate lessons been followed that reflect institutional and professional standards and procedures?
Substantive effectiveness	In what ways, and to what extent, does sustainability assessment lead to changes in process, actions or outcomes?
Transactive effectiveness	To what extent, and by whom, is the outcome of conducting sustainability assessment considered to be worth the time and cost involved?
Normative effectiveness	In what ways, and to what extent, does the sustainability assessment satisfy the following imperatives: <ul style="list-style-type: none"> <li>– Reverse prevailing (unsustainable) trends?</li> <li>– Integrate all the key intertwined factors affecting sustainability?</li> <li>– Seek mutually reinforcing gains?</li> <li>– Minimise trade-offs?</li> <li>– Respect contexts in which sustainability assessment takes place?</li> <li>– Is open and broadly engaging?</li> </ul>
Knowledge and learning	How, and to what extent, does the sustainability assessment process facilitate instrumental and conceptual learning?
Pluralism	How, and to what extent, are affected and concerned parties accommodated into and satisfied by the sustainability assessment process?

*Source:* Bond et al. (2013).

In summary, procedural effectiveness reflects the ability of a legal or administrative process to lead to sustainable outcomes; substantive effectiveness reflects the actual outcomes which need to be sustainable (i.e. effective in this context); transactive effectiveness recognises the financial and time implications of conducting assessments and examines the efficiency of the process; normative effectiveness relates to the individual and social norms, or expectations, that exist in relation to the process and outcome; knowledge and learning reflects the fact that a number of researchers have now recognised them as being determinative of effectiveness; and pluralism recognises the importance of discourses to perceptions of effectiveness and is a topic covered in more detail in Chapter 2 of this book (Pope et al.).

The first four effectiveness criteria have been described in greater detail in Chanchitpricha and Bond (2013). They have long been used as a means of evaluating all forms of impact assessment practice, with procedural, substantive and transactive effectiveness all being considered in the international effectiveness study of EIA which was published in 1996 (Sadler, 1996). Examples of procedural effectiveness criteria can be found in comparative studies of impact assessment procedures, including on EIA (e.g. Wood, 2003) and on SEA (e.g. Jones et al., 2005). Substantive effectiveness criteria have frequently been used to evaluate SEA procedures (e.g. Thérivel and Minas, 2002; Jones et al., 2005). Transactive effectiveness criteria are less frequently used, but examples can be found (e.g. Theophilou et al., 2010). These initial three criteria are relatively easily understood and applied. The fourth criterion in Table 1.1, normative effectiveness, was introduced by Baker and McLelland (2003) and is altogether more problematic. Essentially this criterion of effectiveness recognises the importance of individual and social norms, or values, that are applied in any decision context. By definition, these are not predetermined. In developing their effectiveness framework, Bond et al. (2013) argued that normative effectiveness relates to social norms (with individual norms being covered by the separate pluralism effectiveness category), which they define as the standards with which society expects conformance (Bond and Morrison-Saunders, 2013). Given that 'society' is always context specific, and that they sought to apply the framework as the basis for a comparative study (see Gibson, 2013b; Morrison-Saunders and Pope, 2013a; Retief, 2013; Thérivel, 2013), they used, as a surrogate, six sustainability imperatives outlined by Gibson (2013a); these draw on earlier work identifying decision criteria for sustainable development as briefly outlined below.

Clive George (1999) developed 18 criteria which he argued needed to be satisfied if a proposed development were to be considered sustainable (George, 1999). Gibson et al. (2005) developed a simpler set of eight decision criteria, which significantly overlapped with those of George (1999). These decision criteria were developed based on many years of academic investigation of environmental decision making. They recognised ongoing decision issues, including the difficulty of dealing with uncertainty (see, for example, Wynne and Mayer, 1993; Tennøy et al., 2006), the mutual reliance of social and ecological systems (see, for example, Turner et al., 2003; Liu et al., 2010), the tensions between achieving both intra- and inter-generational equity (see, for example, Okrent, 1999; Shrader-Frechette, 2000), the importance of the precautionary principle (see, for example, Jordan and O'Riordan, 2004; Tickner and Geiser, 2004), the need for more democratic governance (see, for example, Rossouw and Wiseman, 2004; Sneddon et al., 2006), the importance of adaptation, particularly given the limitations of existing assessment and decision-making processes (see, for example, Burton et al., 2002; Smit and Wandel, 2006), and the key development needs of existing populations. Inherent in all these tensions is the inevitable existence of trade-offs in decision making, whereby decision makers acknowledge the difficulty of satisfying all of these criteria and, therefore, trade off achievement of some against failure to achieve others. The fact that trade-offs occur in practice, whereby socio-economic gains have been accepted at the expense of environmental losses, has been researched and documented (Thérivel et al., 2009; Brownlie et al., 2013).

In 2013 Gibson (2013a) set out his six imperatives which he argued were essential for sustainability assessment. Their summarised form provides the basis for the normative

criterion in Table 1.1. We would emphasise however that, for any specific decision context, these imperatives would need to be revisited and amended in line with the social norms in play; nevertheless they provide a useful starting point for discussion.

Bond et al. (2013) added to the first four categories of effectiveness based on literature focusing on the role of knowledge and learning in impact assessment. This raises the possibility that those involved in a proposed project in any capacity might have poor knowledge about sustainable development and, therefore, are potentially less likely to press for sustainable outcomes.

The importance of knowledge and learning to effective assessment outcomes has now been recognised by a number of researchers (see, for example, Nilsson, 2005; Jha-Thakur et al., 2009), with a distinction made between ‘instrumental’ and ‘conceptual’ learning, the former being defined as the type of learning that leads to a change in policy or project design to better deliver sustainable outcomes, with the latter referring to a change in beliefs which should have wider consequences for the way the particular actors behave outside of the specific decision context.

A final category of effectiveness proposed by Bond et al. (2013) is related to pluralism. This category acknowledges the variety of discourses that might be associated with the goals of sustainability assessment and that it is likely that perceptions of effectiveness may vary as a result. The notion of pluralism leads into the study of discourse, whereby different people will have different worldviews – a topic that is covered in more detail in Chapter 2 (Pope et al.).

In summary, a series of criteria have been identified for determining what an effective sustainability assessment process should be like, although it is recognised that the normative and plural nature of some concepts means that these criteria may need modification to suit different contexts. The evidence gathered to date, however, suggests that existing sustainability assessment processes, whilst often performing well, fall short when viewed against all the criteria of effectiveness (see, for example, Gibson, 2013b; Morrison-Saunders and Pope, 2013a; Retief, 2013; Thérivel, 2013). They are nevertheless a useful framework to consider prior to reading the other chapters. The structure of the remainder of the book is explained below. The following chapters contain a combination of conceptualisations, case studies, proposed approaches and reflections, each of which has implications for the effectiveness of sustainability assessment practice.

## 1.5 *HANDBOOK STRUCTURE*

Key to understanding any field of study is a conceptualisation of the current state of theory and practice. This allows us to place new knowledge in the appropriate context, and to be clear on the scope of the new understanding in relation to possible other conceptualisations. Chapters 2 to 4, constituting the remainder of Part 1 of the book, are all conceptualisation chapters.

Important early work in conceptualising sustainability assessment was undertaken by Pope et al. (2004), who set out a typology of assessment processes at that time. In the intervening decade, considerable practice has emerged, further research has been conducted, and new knowledge and understanding have developed. It is thus important to revisit this conceptualisation to map the current landscape of the field as a guide to

the remainder of this *Handbook*. Jenny Pope et al. do just that in Chapter 2, and find some weaknesses in the 2004 conceptualisation which are addressed. In particular, given the pluralism inherent in the concept of sustainable development (as the stated goal of sustainability assessment) and emerging work examining the role of discourse in decision making where forms of impact assessment are undertaken (for example, Runhaar, 2009; Rozema et al., 2012; Hugé et al., 2013), Pope et al. set the scene in terms of sustainability discourses underpinning assessment.

Different discourses of sustainability also exist and often reflect either ‘strong’ or ‘weak’ sustainability (Neumayer, 2003; Bond and Morrison-Saunders, 2011; Hugé et al., 2013). These terms have emerged from the field of economics and so present important context for our understanding of sustainability. In particular, given the prevalence of the three pillars approach to sustainable development, whereby sustainability is underpinned by progress in social, economic and environmental areas, it is important to have a clear understanding of how sustainability is perceived in that underpinning economic pillar. Chapter 3 by Nick Hanley provides a brief introduction to the economics of sustainable development, explains these terms, and discusses the different ‘capitals’ that are accounted for in economic understandings of sustainability, as well as the economic indicators in use for measuring sustainable development at country scales. The inclusion of this chapter reflects the importance of such measures in terms of the development of government policy.

As we have previously discussed, and as highlighted by George (2001), the concepts of inter-generational and intra-generational equity are central to most understandings of sustainable development. Chapter 4 by Lydia Lamorgese and Davide Geneletti, however, highlights how equity is poorly understood and rarely adequately considered in most impact assessment practice, and proposes a conceptual approach through which intra- and inter-generational equity can be embedded together as a unifying concept into sustainability assessment.

Another key variable affecting sustainability assessment practice is scale. Howitt (2013, p. 68) explained the importance of scale in sustainability assessment in terms of the ‘institutional and administrative arrangements across ecological, social, economic and political structures that are themselves scaled’. The point is that the institutional and geographical context in which sustainability assessment fits is critical. Practice can be seen to already apply to different scales, with sustainability assessment of land use plans in England (e.g. Thérivel et al., 2009) and projects in Western Australia (e.g. Morrison-Saunders and Pope, 2013a) as examples. Reflecting the very different decision contexts and therefore sustainability assessment processes, Part 2 of the *Handbook*, incorporating Chapters 5 and 6, examines practice at the regional scale (in this case in Canada) and at the policy level respectively.

Chapter 5, by Jill A.E. Gunn and Bram F. Noble, draws on the argument that impact assessment is better practised at more strategic scales, where it can direct development and plan outcomes rather than react to project proposals (Thérivel et al., 1992). It draws on the rich history of regional scale environmental assessments in Canada and examines how best sustainability might be integrated into existing practice.

In Chapter 6 Camilla Adelle and Sabine Weiland examine sustainability assessment at the policy level at national and international scales, where there has been progress driven by the Organisation for Economic Co-operation and Development (OECD) and by the

European Union (Adelle and Weiland, 2012). They specifically focus on the case studies of the European Union, Germany, Switzerland and the UK in explaining and evaluating the processes undertaken to assess the sustainability implications of emerging policies and legislation.

Part 3 of the *Handbook* examines practice in different sectors, again acknowledging the importance of context in shaping practice. It would not be possible to present a comprehensive review of practice across all sectors, as they are so numerous; for example, the EU SEA Directive (European Parliament and the Council of the European Union, 2001) sets out sectors falling within its scope as: agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use. In this book two sectors are featured: energy (Chapters 7 and 8) and urban development (Chapter 9). The importance of considering the energy sector in any discussion of sustainable development is evident, given the continuing increase in demand for energy at a global scale, and the climate implications of the current reliance on fossil fuel. The continuing expansion and development of our cities are equally critical; the United Nations (2014) indicates that 54 per cent of the world's population lived in cities in 2014, with 28 cities being categorised as mega-cities (10 million people or more), with the number of mega-cities expected to rise to 41 by 2030 (United Nations, 2014).

In Chapter 7, Carla Grigoletto Duarte et al. consider the best approach for integrating sustainability into the decennial energy plans (i.e. plans of ten-year duration) that are produced in Brazil, thus far without appropriate consideration of the sustainability implications. These plans include supply and demand studies for electricity, oil, gas and biofuels and make a fascinating case study in relation to energy given Brazil's development of ethanol as a key renewable transport fuel.

A different energy perspective is provided by Kyrke Gaudreau and Robert B. Gibson in Chapter 8, which introduces an approach based on a move away from energy plans and policies focusing on meeting demand and towards meeting social goals – the 'soft energy path'. Based on this approach they derive principles towards a constructive relationship with energy. They then combine these principles with the broader sustainability principles derived by Gibson et al. (2005) to generate sustainability evaluation and decision criteria for energy applications.

In Chapter 9 Maria R. Partidário and Pedro Pereira draw on the concept of resilience and connect sustainability and resilience thinking, an approach also taken by Gaudreau and Gibson (2010), in an urban context (using Lisbon, Portugal as a case study). The term 'resilience' is increasingly heard in impact assessment circles (see, for example, Slootweg and Jones, 2011; Davoudi et al., 2012; J. Baker et al., 2013) and is a measure of the extent to which a system can absorb change. They develop an urban resilience approach drawing on the work of Gunderson and Holling (2002) and the concept of panarchy. The concept of resilience is also explored in Chapter 13 (see below) by Grace and Pope.

All forms of impact assessment have long grappled with the methods and tools that can be used to conduct all or parts of the assessments (e.g. Bisset, 1980), and there are constant developments in this aspect of impact assessment practice. Porter and Fittipaldi (1998) set out what was 'new and important' at the time of publication of their book, and there has been a continuing evolution of approaches, some of which are reflected in Part 4 of this *Handbook*.

In particular, the concept of ecosystem services has gained popularity since the publication of the Millennium Ecosystem Assessment in 2005 (Millennium Ecosystem Assessment, 2005). In Chapter 10 Davide Geneletti et al. introduce the concept of ecosystem services and how it has been incorporated into impact assessment in general, and sustainability assessment in particular. They then suggest a framework to facilitate the embedding of ecosystem services within sustainability assessment, before concluding with an examination of the institutional barriers and enablers to this embedding. Drawing on research which has identified the importance of institutions and institutional discourses for the effectiveness of impact assessment practice (e.g. Hajer, 1993; Lorenzoni and Benson, 2014), they argue that the existence of a framework will not make something happen in a political setting without considerable effort.

A decision tool which has gained some favour given its ability to help in choosing between alternatives is multi-criteria decision analysis (MCDA), or simply multicriteria analysis (MCA) (e.g. Fishburn and Lavalley, 1999; Janssen, 2001; CoRWM, 2006). It is particularly useful in sustainability assessment applications owing to its ability to integrate the various dimensions of sustainability as well as to combine expert opinion and lay knowledge (and hence embrace pluralism), through the scoring and weighting of issues respectively. Davide Geneletti and Valentina Ferretti present an explanation of MCA and its potential application in sustainability assessment in Chapter 11. They include considerations of sensitivity analysis to test for the robustness of conclusions based on different stakeholder weightings, and present three case study applications of MCA, one of which includes an innovative spatial MCA (through the application of geographical information systems, GIS). The learning from the three case studies and their relevance to the practice of sustainability assessment concludes the chapter.

In their original conceptualisation of sustainability assessment (reviewed in Chapter 2 of this *Handbook*), Pope et al. (2004) identified 'objectives-led integrated assessment' as one of the three types of assessment; the English sustainability appraisal process is an isolated example of this concept in mandatory practice. In Chapter 12, Samuel Hayes and Thomas B. Fischer explain the English process and the current state of the art in terms of the setting of sustainability objectives, along with the associated indicators that act as measures of whether alternative policies within the plan will achieve the objectives. They also investigate the issue of trade-offs across sustainability objectives that typify practice, as well as the knotty problems of reductionism whereby complex environmental systems are broken down into discrete components which will not always properly represent the whole (Bell and Morse, 2008; Bond and Morrison-Saunders, 2011). They conclude with reflections on the English approach and what can be learnt from it more broadly.

Chapter 13 takes as its starting point that there have been recent calls for impact assessment to embrace not only resilience thinking (as illustrated in Chapter 9) but systems thinking more generally, that is, to recognise the interconnected and dynamic nature of socio-ecological systems. Arguing that human cognition is limited in its ability to deal with either feedback or exponential growth, two considerations in understanding system dynamics, William Grace and Jenny Pope use computerised systems dynamics modelling tools firstly to explore the meaning of resilience-thinking concepts and heuristics and then to develop a conceptual systems model for sustainability, which they define as 'enduring human wellbeing'. They argue for an approach to sustainability assessment

that recognises nested and connected systems at different scales, and demonstrate the use of systems dynamics as a useful tool in such a process.

In Chapter 14 Michelle Audouin et al. introduce 'sustainability science' as a means of achieving sustainable development through its practical, problem-focused orientation, emphasis on the relationships between social, ecological and economic aspects in a systemic view of the world, and the adoption of a transdisciplinary approach to conducting research. They focus on the need for systems-based approaches to sustainability assessment that integrate knowledge across disciplines and stakeholder values. In their call for a systems approach, they reflect arguments that reductionism is flawed (as discussed in Chapters 12 and 13, and see Bond and Morrison-Saunders, 2011) and highlight the contribution of complexity theory to overcome reductionism. Their call for transdisciplinarity reflects arguments that different framings exist across different stakeholders, particularly in contexts that cross the social and ecological divide. They provide examples through case studies of how systems thinking and transdisciplinary approaches can benefit sustainability assessment.

Governance arrangements have been identified as key factors influencing the effectiveness of EIA (Arts et al., 2012) and, given sustainability assessment works in the same governance context, we can assume the same applies. Craik et al. (2012) analysed three case studies from three very different decision contexts (in Canada, Australia and Ukraine) using three different dimensions of governance as a basis for analysis: institutional, political and regulatory form. They found that the case studies depicted great differences between the three contexts, based on all three governance forms. They make the point that, although the processes analysed might share the same goal of sustainable development, there is no substantive legal force behind this goal. Instead, the legal force applies to the procedural steps, and there is considerable scope for the various institutions and other actors involved in the process to vary between specific decision contexts, and to vary significantly in terms of the power they wield. Public participation in decision making is a key governance mechanism and is now considered a right, although practice varies considerably. Arnstein (1969) set out a useful classification in the past which still provides the benchmark against which particular approaches are judged. Minimum standards in many countries are now set through international agreement, for example through the Aarhus Convention (United Nations Economic Commission for Europe, 1998). Part 5 of this *Handbook* therefore examines governance and engagement in the context of sustainability assessment.

In Chapter 15, A. John Sinclair et al. identify the essential elements of public participation for sustainability assessment; they specifically explain how to address power imbalances, which are increasingly recognised as affecting the objectivity of other forms of impact assessment (e.g. Flyvbjerg, 1998; Richardson, 2005; Cashmore and Axelsson, 2013). Sinclair et al. identify five emerging directions for meaningful participation and outline what each entails.

Chapter 16 by Janette Hartz-Karp et al. picks up this theme and specifically considers the potential contribution of 'deliberative collaborative governance (DCG)', as the hybrid of deliberative democracy and collaborative governance, to sustainability assessment. To do this, the authors draw on recent action research conducted in Western Australia through which the principles of DCG were applied and their effectiveness in delivering not only meaningful, representative engagement but positive outcomes for

sustainability demonstrated. They then apply some of the lessons learnt to another case study, in this case a community affected when a large and controversial development project was progressed to a certain point (and various impact assessments undertaken) but then did not proceed. With the benefit of hindsight they consider hypothetically what could have been done had a sustainability assessment informed by the principles of DCG been undertaken, as well as discussing what could still be done now to co-create a more sustainable future for this community.

Retief et al. (2013) introduced learning from the field of psychology to explore the handling of trade-offs in decision making. This research recognised that one of the key roles of impact assessment is to inform, and influence, decision makers, but that decision making is inherently complex. A key author in the field of decision complexity associated with individual choice in particular is Daniel Kahneman (e.g. Kahneman and Tversky, 1984; Kahneman, 2013). In Chapter 17 Francois Retief et al. explore further learning that can be derived from Kahneman's work, and from the psychology field in general, to better understand and enhance the practice of sustainability assessment. They consider issues of choice, prediction and communication within sustainability assessment, and use this as a framework around which to synthesise learning.

Part 6 of the *Handbook* rounds out the material that precedes it with conclusions and an epilogue. Overall conclusions are provided in Chapter 18 by Pope et al., including key learning points arising from the *Handbook* chapters along with some reflections on the state of the art of sustainability assessment. The final words for the *Handbook*, however, go to Robert B. Gibson in an epilogue which takes a step back to provide a big picture overview of the field of sustainability assessment in terms of where it has come from and future directions and challenges for practitioners.

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