

1

Knowledge creation for sustainable innovation

THE KCSI PROGRAMME

René J. Jorna

There is something peculiar about innovation in the Netherlands, and probably in other countries too. On the one hand, various independent sources both internal and external (Weggeman 2003; van Ees and Postma 2002; European Commission 2004) indicate that innovation is in bad shape. The growing tendency is to import technologically educated people from outside rather than produce them 'in-house'. Budgets for innovation and research at university level are decreasing. In addition, Dutch multinationals, comprising companies such as Shell, Philips, AKZO-Nobel and Unilever, are reducing their participation in innovation.

On the other hand, according to the Dutch Central Bureau for Statistics (CBS 2004), sufficient new products are nevertheless being developed. However, these products do not find their way commercially into society as one would hope. Furthermore, and this is not insignificant, in the Netherlands there is a rich tradition—in universities, in R&D units of companies, and in government agencies—which ensures a solid foundation in overcoming deficiencies.

This combination of positive and negative features is typical for the theme of innovation, not only in the Netherlands but also in many other European countries. Simply, innovation means either realising something new out of nothing or realising something new based on what already exists (Schumpeter 1934). There are some important differences between these two approaches. With the former there is no need to be competitive or to change the existing cognitive and social landscape. But it is a different case with the latter. Then, it is a matter of what Schumpeter describes as 'creative destruction'. It is worth noting, however, that Schumpeter is mainly referring to economics and sociology: that is, to a high aggregation level for innovation. He does not

discuss the effects of innovation on people's thinking, knowledge and behaviour. We return to this in Chapter 6.

With regard to the processes and aims of innovation, we have several observations to make. First, many innovations are long-term activities. For example, the development of haemodialysis equipment took more than 100 years (Cijssouw *et al.* 2004). This is an extreme example, although periods of 10–15 years are common in *radical* innovations regardless of the domain or product. A great deal of time, effort and money needs to be invested.

Second, innovations are not guaranteed to succeed. Many innovations fail, but it is very difficult to determine precisely the reasons for failure—lack of financial and/or human resources, incomplete knowledge, poor co-operation, absence of materials, etc. Failure is likely to be due to a matrix of factors, with knowledge a key one; but how a potentially successful innovation turns into a failure, and at what phase in the innovation process, is often impossible to determine.

Third, traditional discussions about innovation are often one-dimensional, tending to refer only to material aspects. Moreover, this view is shared by a large number of rating systems within, for example, the Dutch Ministry of Economic Affairs and the EU. In this way innovatory approaches tend to be restricted to product or production process innovations. This is inadequate. Innovations can also relate to new services, organisational forms and ways of working. In this book we will make a case for a much broader vision than the traditional one.

Fourth, we believe that the importance of technology in innovation is strongly overestimated. This is, we should stress, not the current consensus in the Netherlands where universities bemoan the lack of resources available for technological innovation and the lack of interest in, and value placed upon, the exact sciences. This is true in the sense that over the past few years there has been little growth in the number of students signing up for the exact sciences. However, it is not true if one considers the large number of (natural) scientists who no longer work in their own disciplines but are occupied in management, consultancy and business policy matters.

Fifth, innovation is tied to knowledge. Innovation starts with knowledge, it elaborates that knowledge or generates new knowledge, and produces knowledge as the final outcome. Thus, knowledge is the engine of innovation (see Chapter 6). Furthermore, innovation is directly linked to people who realise new knowledge or extend existing knowledge. Without such people there would be no innovation. People are the carriers of knowledge. Their culture and society is largely immaterial, although the importance of background is less strong for technological innovation than for non-technological innovation. If the influx of people from other cultures is too large, the role of people as carriers of knowledge is affected. Foreign researchers who develop knowledge will return to their home countries after some time. This means that knowledge will flow away, which creates problems regarding the continuation of education in the education-giving countries. As we will discuss, knowledge is not a free-floating commodity, as economists believe. Knowledge, without human beings, socially and culturally embedded, is not possible. Innovation is also a process. Besides creating and producing knowledge, it also requires that knowledge is transferred, available, accessible and usable.

Sixth, nowadays individuals rarely realise innovations. Even the most brilliant inventor needs other people to work out details and to conduct tests and case studies, as well

4 SUSTAINABLE INNOVATION

as to convince others that the innovation is as brilliant as the inventor thinks it is. Innovation means working together to exchange knowledge and information. In the modern climate of innovation the individual inventor or innovator has become an exception—the current state of affairs requires teamwork. And, in order to be useful, innovations need to be introduced, accepted and adopted.

In summary, we conclude that innovations take time, there is no guarantee of success and there is currently too little focus on services and organisational forms. Furthermore, it can be stated that innovation is not just a scientific exercise, but that in principle it is about knowledge, with people as the carriers of this knowledge. Thus, innovation will succeed only if people co-operate. This book deals with these subjects in a theoretical sense as well as from the practical perspective of a number of organisations.

Regarding the aforementioned issues we take the following positions:

- Innovation is about products, services and organisational forms
- Innovation is about knowledge carried in the minds of people
- Innovation requires co-operation
- Innovation should be seen as an ongoing and enduring process

We think the phrase **sustainable innovation** effectively describes these four positions. We will explain this in greater detail in the next section. This will be followed by an overview of the Netherlands Initiative for Sustainable Development (NIDO¹). Then, we go on to discuss the conceptual core of NIDO—the Knowledge Creation for Sustainable Innovation (KCSI) programme. This book is an extended description of, and reflection on, the KCSI programme. Finally, we explain the structure of this book.

Sustainable innovation

In the previous section we noted that the innovation theme evokes a large amount of debate. Indeed, it appears that we have complicated the situation by postulating the idea of sustainable innovation. At first sight sustainable innovation seems to deal with two things—sustainability and innovation. However, we do not go along with the obvious interpretation that sustainability is related only to ecology and the green environment, and that innovation mainly refers to technological matters. This would imply that sustainable innovation is about technological modernisation in the field of the environment and ecology. Instead, we are eager to define our own interpretation of sustainable innovation. We believe that sustainability in the environmental sense is always directly or indirectly connected to the way in which people possess and organise knowledge. In general, managing and making this knowledge operational takes place in

1 The Nationaal Initiatief Duurzame Ontwikkeling foundation was established by the government of Prime Minister Wim Kok between 1999 and 2004 as a means of investing in the knowledge infrastructure.

organisations, firms, enterprises and institutes. In Chapter 3 we return to various definitions of sustainability.

As mentioned previously, innovation can mean that something already in existence is renounced or abandoned and something new replaces it. As well as products, services and organisations themselves can be innovated; a good innovation always means that, within a certain context, knowledge has been created. In this book we want to focus on sustainable innovation in the human and organisational sense.

Sustainable innovation is accomplished by **knowledge creation**, and the ways and structures that embed this knowledge in organisations need to be analysed and stimulated. A proper innovation process results in making knowledge sustainable. The essence of sustainable innovation is shaped by a process perspective on sustainability. Whenever we say that a particular product, production process or service is sustainable, we mean that a balance has been achieved between the three pillars of sustainable development—‘planet’, ‘profit’ and ‘people’, where ‘planet’ is often the key pillar. A car can be sustainable because it runs on hydrogen, or electricity can be sustainable because it is generated by biomass. In the same way we say that innovation can be sustainable. For example, a new material has been discovered that is less environmentally damaging or a particular production process has been developed that produces less harmful emissions. These are obvious examples of sustainable innovation.

However, there is more to it than this. It is very hard for complex systems, such as firms, enterprises and organisations, or for complex transactions, such as innovations, to determine a state of sustainability. One cannot simply measure the degree of sustainability of an enterprise or an innovation as this changes over time. We therefore suggest transforming the term ‘sustainability’ to ‘making sustainable’. By ‘making sustainable’ we want to raise the issue that the organisational processes in the organisation are constantly changing. The same goes for innovation. An innovation is not there for a limited period of time, after which it is finished. Innovations endure as processes rather than projects. However, in the innovation process there has to be a constant focus on sustainability. Consequently, from the perspective of the human and organisational sciences, design rules have to be formulated and implemented such that the innovation process is able to sustain itself.

In the KCSI programme sustainability and knowledge are combined in two ways. First, it is important to know whether sustainability concerns planet, people or profit. This holds for the usual processes in organisations as well as for innovation processes. We call this **knowledge of sustainability** (KoS). Second, it is also important to know whether this knowledge is used efficiently, whether it is shared, whether the conditions for innovation creation are sufficient and whether it has a human dimension. We term this **sustainability of knowledge** (SoK). We will explain KoS and SoK later in this chapter and in more detail in Chapter 3.

NIDO: the organisational context

This book is one of the achievements to arise from the NIDO foundation’s KCSI programme. NIDO brings together enterprises, governments, social organisations and sci-

entific institutions in programmes aimed at putting sustainability into practice. Such co-operation leads to solutions which receive concrete support within organisations or enterprises. In this way a solid basis is formed for the further spread of sustainable development within society. The aim of NIDO is to link prosperity to well-being by ensuring that economic growth and environmental improvements go hand in hand. An important second objective of NIDO is to strengthen the knowledge infrastructure in the Netherlands. NIDO sees its task as building bridges between various knowledge disciplines and social sections. In its programmes NIDO stimulates public–private co-operation.

NIDO translates society's demands for sustainable economic development into practical reality. This requires a joint effort in order to combine the experience and insights of people from the corporate world, social organisations, knowledge institutions and the government. To achieve this, NIDO is engaged in drawing up programmes around key themes. Themes in previous years were:

- From financial to sustainable efficiency—about financial auditing
- Sustainable outsourcing—about relations between different enterprises
- Values of water—about the behaviour of governments regarding the management and usage of water
- Market opportunities for sustainable products—about the role of marketing within the frame of sustainable products and services

The KCSI programme takes a central place in this book with its main theme of innovation and its subtheme of how sustainability in innovation and innovation processes can be determined and stimulated.

In particular, NIDO tries to show what a sustainable approach achieves. This will emerge in Part C of this book which deals with projects in organisations and firms. NIDO works together with current initiatives and continues these so that faster and bigger leaps can be made in sustainable development. In the next section, we will discuss the contents of the KCSI programme, how it is structured, what its objectives are and what results are intended.

Knowledge creation for sustainable innovation

Orientation

The KCSI programme aims at the sustainability of innovation processes. The process of innovation and the role of knowledge and of the people who possess that knowledge form its basis. In this context, sustainable innovation can have two meanings (see also McElroy 2003).

In the first place within an organisation the innovation itself can be aimed at sustainable services, products or production processes. Take, for example, the hydrogen technology that is increasingly considered as a key technology for the near future, provided hydrogen is not produced by burning natural gas, oil or coal. Hydrogen as an

energy source is efficient, it can also be used at a small-scale level, and has a high output. It neither has the ecological disadvantages that are attached to the use of biomass and fossil fuels nor the cost problem of the solar energy collectors or the low efficiency of the harnessing of wind energy. Take an enterprise that by means of innovation develops an efficient method to change from gas and oil as energy carriers to hydrogen technology as an energy provider. This enterprise is practising sustainable innovation.

In the second place sustainable innovation may refer to structuring an innovation in such a way that it becomes sustainable. This means that the organisation of innovation as a *process* is structured in such a way that it is a component of the value chain of an organisation. Consequently, in this (second) sense, sustainable innovation touches the core of an enterprise or organisation: namely, the knowledge processes. The aim here is to influence the way in which (the people in) the organisation deal(s) with knowledge: that is, the way in which knowledge is created and produced, the way it is made accessible and is shared, and the way (people make sure) it is used.

In essence, sustainable innovation is about knowledge processes that form the core of an organisation. It influences the ways in which the organisation deals with knowledge. The innovation process is inextricably connected with all kinds of knowledge creation and management. It is very difficult for organisations as complex systems or innovations and transitions as complex situations to determine a condition of sustainability. An enterprise or innovation cannot be measured by a certain degree of sustainability since sustainability is a dynamic process and innovations and enterprises are constantly changing.

Sustainable innovation is realised by knowledge creation. The aim is to stimulate and facilitate this knowledge creation which is linked to the ways and structures to embed knowledge in organisations. According to Argyris and Schön (1978), knowledge creation is **second-order learning**, which means **learning to learn**. By contrast, **first-order learning** is increasing or accelerating existing knowledge. This first-order learning is important, though Argyris and Schön also make it clear that in order to achieve actual renewal 'learning to learn' must be included. Only then is knowledge created. A sound **process of innovation** ensures preserving the SoK.

The essence of the KCSI programme entails this process perspective with respect to sustainability. Whenever we say that a product, product process or service is sustainable, we want to indicate that a balance in the three pillars of planet, profit and people is achieved. In the same way one can say that an innovation is sustainable. For the sake of convenience we call this the **static interpretation** of sustainable development. Sustainability is a condition by which—according to certain criteria—it can be determined, whether or not it has been achieved. We return to various interpretations of sustainability in Chapter 3.

The aforementioned formulation of sustainable innovation also applies to conducting business in a sustainable way. This means that the business processes are structured and embedded in such a way that the organisation or firm does not exploit the environment or the society in which it operates, but rather interacts with it on a mutually beneficial and ongoing basis. Preserving sustainability in both innovations and organisations leads to a continuous stacking, restructuring and adjusting of the process itself. This stacking means that existing knowledge is being adjusted and complemented. In addition, new knowledge is created and existing knowledge is elaborated. Our **process perspective** is inextricably connected with all aspects of knowledge creation and man-

agement. Empathy with, and awareness of, sustainability can take innovation to a higher level and, in this way a continuous impetus can be given to preserve sustainability.

An organisation consists of layers

Organisations can be classified in a number of ways: for example, by primary and secondary processes or by functional areas such as marketing, logistics and finance. In Chapters 4 and 5 we will come back to these classifications.

If we consider sustainable innovation as an ongoing and enduring process we can also consider organisations in the same dynamic way, especially in relation to the intervention levels. These levels are combined with an ontological classification of organisations. Going from top to bottom, we then say that an organisation has the following levels:

- Organisational objectives
- Organisational processes
- Behaviour and knowledge of the employees
- Learning abilities of the employees

All four are important for effective innovation, but the last two particularly so. How can the creation of a **learning organisation** be stimulated in such a way as to generate awareness of the fact that one is dealing with SoK?

Making change happen is likely to be very different at each of these intervention levels (van Raaij 2001). Changing the objectives of an organisation is quite easy, as is bringing in KoS at this level. With a little imagination an objective can be reformulated in an instant. It only consists of words. It is harder to change processes where an organisation’s structure may be at risk, and even harder to change people’s behaviour. Hardest of all is changing learning ability (see Table 1.1). In summary, deep changes are more difficult but also more effective. In our terms, they are more sustainable. While at an abstract level within the organisation one can simply speak of SoK, its implementation at the operational level may cause enormous problems. After all, SoK requires an organisation to consist of **learning people** (who make up the so-called learning organisation). This means that a sufficient number of stakeholders must be involved.

	Increase in KoS	Increase in SoK
Organisational objectives	Easy	Easy
Organisational processes	Easy	Difficult
Behaviour/knowledge	Difficult	Extremely difficult
Learning/self-evaluation	Difficult	Extremely difficult

TABLE 1.1 Changing sustainability in relation to preserving sustainability, according to levels of intervention

It may be clear that this new way of business development cannot be carried out without a fundamental approach to the knowledge infrastructure and the help of knowledge management (see Chapters 6–8). In the remainder of this section, we will elaborate on the different factors dealing with knowledge. Business and knowledge processes are aimed at knowledge creation and knowledge production, knowledge use and knowledge management (McElroy 2003).

A conceptual framework for sustainable innovation

In previous sections we dealt with the main terms **innovation** and **sustainability**. We have also presented the concepts of **knowledge** and **organisation**. How, then, are these concepts connected or, to put it another way, how do they form a framework? To provide a renewing perspective on innovation and sustainability we will start from the central terms ‘organisation’ and ‘knowledge’.

There are two ways—internal and external—of looking at an organisation’s right to exist. An organisation’s internal reason to exist lies in the fact that there are many things that individuals cannot achieve alone. Providing insurance services, manufacturing a car or publishing a book require collaborative effort. This leads to a division of labour, functions or tasks that need to be co-ordinated (see Chapters 5 and 6).

Organisations’ external reason to exist is to supply a product or service for which there is a market demand. Business development is the result of a successful match between supply and demand, and business processes are organised in such a way as to attune these two elements. These processes are basically transformation processes converting a particular input (such as raw materials) to a particular output (a product or service) by the addition of knowledge. Since a large number of parties are either directly or indirectly involved in the organisation (stakeholders, employees, governments and customers), structuring an organisation is a complex matter and requires a system-oriented approach.

Whether the reason for existence is internal or external, it is the employees who take centre stage as they are the ones who possess, share, develop, use and distribute knowledge. So, an organisation consists of people, artefacts (such as buildings and computers) and social constructs (such as opening hours and hierarchies) (see Chapter 6).

Three principles of classification

The theme of people and organisation brings us to the first classification principle in this book. We can make a classification of people through groups and teams, according to departments, enterprises and also according to society and culture as a whole. This can be described in terms of levels of aggregation: for example, from low to high or from micro through meso to macro levels. This will be discussed more thoroughly in Chapter 4.

In carrying out tasks people create, share and use knowledge. This knowledge dimension is the key to our second classification principle for two reasons. In the first place it characterises us as humans. Without knowledge we would simply rely on instinctive reflexes, standard responses and behaviour patterns. Second, knowledge is the raw material, the engine and the final outcome of innovation. Whether it concerns

knowledge about materials, technical knowledge, organisational knowledge, creativity or design knowledge, innovation cannot do without it. A distinction can be made between **knowledge content** and **knowledge type**. Knowledge content is what is known, for example, with regard to disease (see Chapter 16), water management or synthetics manufacture (see Chapter 11). Knowledge type refers to the way in which knowledge is presented and shown. For example, knowledge can be expressed by behaviour, speech, in writing or through visual imagery. A further distinction is between knowledge in the **primary process** of an organisation and knowledge in the **secondary process**. The primary process refers to the main objective of an enterprise or organisation while the secondary process relates to management, finances, planning and administration. The distinction between knowledge content and knowledge type applies to both types of process. The classification shows in which process and for which task knowledge is used and also the nature of the division of knowledge types. This is discussed further in Chapter 6.

Innovation and knowledge are closely linked. Since innovation is such a vast concept and takes a central place in the KCSI programme it is dealt with in detail in Chapter 2.

Next to the classification dimensions of **aggregation level** and **knowledge distinction**, there is a third classification principle. This principle is related to the sustainability concept itself—a term frequently used and interpreted in many different ways (Faber, Jorna and van Engelen 2005). The most influential definition of sustainability was the one made by the Brundtland Commission in 1987. It defined sustainable development as (WCED 1987, as reported in Garcia and Calantone 2002: 112):

a process of change in which the use of resources, the direction of investments, the orientation of the technological development and institutional change are all in harmony and do not compromise both current and future possibilities to meet human needs and wishes.

In its definition the Brundtland Commission gave a central place to development—a process that makes use of various resources. This use of resources has to be such that not only current generations but also future ones will be able to utilise them. Another definition of sustainability was articulated by John Elkington (1997). He refers to sustainability as finding a balance between the ‘triple P-areas’ of planet, people and profit.

In this book we will try to follow and further apply the Brundtland Commission’s and Elkington’s definitions by considering sustainability as the balance between the matter, object or construct and its social and natural environment. Therefore, a matter, object or construct is sustainable if its internal structure is in a dynamic balance with its social and natural environment. A dynamic balance means that the environment can be used, but also that the environment itself ‘uses’ the matter, object or construct. This formulation is derived from a remark made by Herman Wijffels, chair of the Dutch Social Economic Council, at a NIDO meeting in April 2002 where he said: ‘Sustainability is realising a reduction in offload(ing) or in devolvement.’ **Offloading** means burdening, destroying or exploiting the environment. Reducing the degree of offloading reduces environmental damage both in the short and long term, thus conforming to the Brundtland Commission’s position that sustainability must take account of future generations. The idea of sustainability as a reduction in the degree of offloading enables us to deal with sustainability in a more operational way. Thus, discussions can focus on how to reduce offloading, who is responsible, how long it is likely to take and whether there

are any disadvantages. Such an analysis helps to formulate effective measures to reduce offloading. This approach to sustainability results in the third classification principle and is discussed in detail in Chapter 3.

The organisation of the programme

The focus on both sustainability and the preservation of sustainability is expressed in two so-called **leap projects**. These are projects that are apt to realise leaps forward resulting in discontinuous positive changes. The aim of leap project 1 is to deal in a better, more transparent and more effective way with KoS in its broadest sense, especially in innovations. The KoS leap project consists of a number of business projects in which each organisation works on a product, service or market innovation in order to embed the concomitant KoS more thoroughly. Participating organisations are: Biosoil (Chapter 10); Synthetics House (Chapter 11); Optichem (Chapter 12); Philips (Chapter 13); and AVEBE (Chapter 14). The various business projects within KoS are parallel projects, but also interactive ones. Leap project 1 focuses on the people and planet pillars of sustainability.

Leap project 2 aims to sustain knowledge in business processes, tasks and other types of organisational activities in order to realise SoK. This leap project puts more emphasis on the process approach than does the KoS project. SoK is directed at using knowledge without wasting it, preserving knowledge and structuring business processes in such a way that innovation as a process of knowledge creation continues to take place. The aim of SoK is to give concrete form to the people perspective of sustainability in particular. The participants in leap project 2 are: the Dutch mental healthcare sector (Chapter 15); Academisch Ziekenhuis Groningen² (AZG) (Chapter 16); Grontmij (Chapter 17); and Sociocracy in Reekx, ATOL and Endenburg (Chapter 18).

Objectives of the programme

For the research programme as a whole, as well as the individual business projects, objectives have been formulated at various levels. At the level of the separate organisation it is important to give an impetus to the innovation in question. In addition, within each organisational project an objective is formulated in the field of KoS or SoK: for example, the re-use of knowledge concerning a particular content area of sustainability or increasing the co-operation with external parties with respect to soil remediation (see Chapter 10). One level higher combines organisational projects within a leap project in order to provide an insight into the preconditions for realising either KoS or SoK. These are objectives at the level of the leap projects. The highest level of the whole research KCSI programme deals with two kinds of objectives—designing instruments and methodologies on the one hand, and exploring and testing empirically a conceptual framework in the field of sustainable innovation on the other. In the overall programme, methodologies and structures are developed by means of instrumental objectives enabling organisations to preserve the sustainability of their innovations. Further, software has been developed to support and implement the aforementioned methods

2 Academic Hospital Groningen. Changed to the University Medical Centre Groningen in 2005.

and structures in organisations (see Part B and various business projects in Part C). With regard to the conceptual framework, sustainability in relation to innovation will be further defined and stipulated in terms of knowledge and (second-generation) knowledge management. This implies that insights and methods will be developed that enable organisations to recognise existing knowledge and to deploy this knowledge for the benefit of sustainable innovation. Through this range of objectives the sustainability of innovations can be embedded in a methodological and scientific way into knowledge management in and around the innovation process.

Methodology applied in the programme

The programme outlined in this book has both a conceptual and an empirical component or, in other words, theoretical and practical components. The conceptual framework is laid down according to three lines of classification, namely:

- Various aggregation levels
- Knowledge content and knowledge type in primary and secondary processes
- Applying sustainability as a reduction in offload (or devolvement)

In the organisational projects, the empirical component is realised. These projects have not been selected as representative random examples out of a large collection of possible projects; they have been selected from the perspectives of innovation, the discussion about sustainability and the theme of knowledge creation and knowledge management. Caution should be used in generalising the experiences reported here to all types of innovations and discussions concerning sustainability. This is certainly not our presumption. Methodologically speaking we are dealing here with explorative research rather than research based on testing hypotheses. In this context, we find ourselves in the pre-stage of the empirical cycle (de Groot 1961). At the same time this programme includes design research carried out according to a step-by-step plan going from analysis and diagnosis via design towards change. In each of the organisational projects, analysis, diagnosis and design are dealt with, one way or another.

The structure of the book

The book consists of four main parts. Part A presents the conceptual framework. Part B contains a number of instruments, questionnaires and methodologies. Part C, the largest, deals with the organisational projects that are subdivided into the *KoS* and *SoK* leap projects. Part D contains conclusions and a checklist. The various parts and chapters are structured as follows.

Part A describes the conceptual framework in six chapters. Chapters 2 and 3 deal with the basic terms of innovation and sustainability. In Chapter 2 we discuss different kinds of innovation, phases in innovation and the difference in radical and imitative innovations while in Chapter 3 we discuss sustainability. Chapter 4 deals with levels of aggregation, from individual to organisational. These are elaborated in Chapters 5 and

6, with Chapter 5 taking an integrated stance concerning organisational forms and coordination mechanisms, business development, business models and management. In Chapter 6 the theme of knowledge, knowledge management and knowledge creation is discussed.

In Part B, instruments and methods of analysis are described based on the work of others or developed by ourselves. We discuss these instruments and methods separately because they go beyond the individual organisational projects or domains. In Chapter 7 a **stakeholders' analysis instrument** is discussed while Chapter 8 presents a method to **map domain images**: for example, of sustainability. Chapter 9 deals with a different way of classifying knowledge than with the classical production rules by using **case-based reasoning**. Many issues in sustainability are difficult to categorise and cannot be easily dealt with by simple causal chains. In these situations case-based thinking may offer an alternative.

In Part C the KoS and SoK business projects are discussed separately. In each business project the related research is described, but attention is also paid to the three themes of innovation, sustainability and knowledge type.

- The KoS leap projects are:
 - **Chapter 10:** Biosoil—designing a stakeholder instrument to support decision-making for soil remediation
 - **Chapter 11:** SyntheticsHouse—the development of a chain of innovation in small and medium-sized businesses (SMEs) in order to lift synthetics innovation to a higher plane
 - **Chapter 12:** Optichem—the development of software in the form of a **decision-support system** (DSS) to improve the use of chemical substances in the paper and cardboard industry
 - **Chapter 13:** Philips—the formulation of social focus areas in product development
 - **Chapter 14:** AVEBE (a global agro-starch company)—the development of an improved DSS for various groups of potato growers
- The SoK leap projects are:
 - **Chapter 15:** Sustainability within the Dutch mental healthcare system—knowledge infrastructure, knowledge management and learning
 - **Chapter 16:** AZG—improving the deployment of knowledge and skills in the curriculum innovations of medical specialists
 - **Chapter 17:** Grontmij—analysing inter-firm alliances to improve the integration of knowledge of sustainability
 - **Chapter 18:** Sociocracy and the sustainability of knowledge—Reekx, ATOL and Endenburg

Finally, in Part D we deal more thoroughly with the final outcomes of all the projects, incorporating the themes of sustainability, knowledge creation, knowledge type, organisational forms and innovation. As already mentioned, the overall research programme does not test hypotheses. Therefore, the projects should not be regarded as representative case studies. Our aim is to study actual practice in a systematic way. At the outset of the KCSI research programme, we found ourselves short of a coherent con-

ceptual frame in the field of innovation and sustainability. We consider Part D to be a representation of the final outcomes of our research, both in a theoretical and in a practical sense. In Chapters 19, 20 and 21 we provide some conclusions regarding, respectively, innovation, sustainability and knowledge. In Chapter 22 we further operationalise the concept of sustainability as a reduction in offload or devolvement and, in Chapter 23, we provide a short checklist for organisations involved with, or interested in becoming involved with, sustainable innovation.