THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Demonstration Projects for Sustainable Building:

Towards a Strategy for Sustainable Development in the Building Sector

based on Swedish and Dutch Experience

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Abstract

Demonstration Projects for Sustainable Building: Towards a Strategy for Sustainable Development in the Building Sector based on Swedish and Dutch Experience

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This thesis explores demonstration projects as a potential strategy for supporting processes towards sustainable development in the building sector through making mainstream building more sustainable. The research question has been approached in four empirical studies carried out in Sweden and the Netherlands, which study demonstration projects for sustainable housing from different perspectives. These are: 1) two case studies, 2) qualitative interviews with key actors, 3) a study of the image conveyed by the Swedish trade press, and 4) a study of the image conveyed by *The Swedish Architectural Review*. The findings are discussed using a framework presenting the notions of sustainable development and sustainable building, conditions for learning and development in the building sector as well as the findings from earlier research in the field. The thesis indicates that demonstration projects have an important role in the processes towards sustainable development in the building sector. The demonstration project provides real-world data, makes sustainable building a tangible and visible concept and is a means of learning through doing for the actors involved. The demonstration project becomes a reference to what sustainable building is and how this can be accomplished. The demonstration project has the potential of becoming a strategy for systematic successive learning and development on the path to reaching long-term abstract objectives for sustainable development through realistic advancements and in accordance with conditions for learning and development in the building sector. However, in order to become an effective strategy, deficiencies in contemporary demonstration projects have to be solved. This concerns the lack of incentives and interest for learning; deficiencies in the production of reliable and useful information; and the lack of institutions for information dissemination. The fact that demonstration projects are handled as special projects also impedes their influence on mainstream building. Moreover, ideals in contemporary demonstration projects often fail to address ideals and interests among actors in the building sector. The thesis provide a basis for the enhanced understanding and use of demonstrations projects, both from a theoretical and a practical view, and discusses the production and dissemination of reliable and useful information as well as factors that will affect the influence of demonstration project on mainstream building.

Keywords: demonstration projects, sustainable building, sustainable development, architecture, housing, building sector, case studies, information dissemination, change agency, learning from experience, discourse in trade press

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Paula Femenías, July 2004

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Chapter 1 Introduction

This thesis explores the significance and the relevance of the *demonstration project* as a strategy to develop contemporary building practices in a process towards sustainable development as described by the Brundtland Commission (WCED, 1987). The demonstration project and the 'good example' are increasingly common features in support of sustainable development in the building sector, as well as in other societal sectors, both nationally in Sweden and internationally (VROM, 1997; Sustainable Building: Framworks for the Future, 2000; Miljövårdsberedningen, 2000; Rethinking construction, 2002; The Swedish Environmental Protection Agency, 2003; WGSC[1], 2004). Accordingly, it is motivated to explore and analyse the effectiveness and mechanisms behind the demonstration project and the 'good' example as strategies for the process of change towards sustainable development in the building sector.

1.1 The demonstration project as research field

In the background to this thesis, we find contemporary political visions and objectives for *sustainable development* together with commitment and involvement in the building sector for the setting of an agenda for *sustainable building*[2] and the implementation of the same. The building sector and the built environment have been pointed out as two key areas of concern for sustainable societal development both in a Swedish and an international perspective (CIB, 1999; Miljövårdsberedningen, 2000). Sustainable development concerning building activities and the built

[1] The Working Group for Sustainable Construction for the European Commission, in this thesis called by the abbreviation WGSC.
[2] In the thesis the shorter abbreviation, *sustainable building,* will be used when addressing questions concerning building practices that support sustainable development.

environment must be seen as a necessary process for change. The notion of sustainable development and the agendas for sustainable building are further discussed in Chapter 2.

A starting point for this thesis is found in earlier compilations of examples of sustainable building projects in Sweden and the Netherlands (Femenías, 1994; Femenías, 1999a). The purpose of these compilations has been to gather and to spread experience from sustainable building projects and to provide inspiring examples. Through the work with the compilations two questions were formulated that have been further developed in this thesis, namely: *how to study* and *how to present* examples of sustainable building in order to provide useful information for actors in the building sector.

A strategy for promotion of sustainable building

The 'good example' and the demonstration project are currently propagated as being instruments for supporting sustainable building in Sweden as well as within the European Community and the rest of the world. The European Commission (for example through DG Environment and DG Tren) has made considerable efforts with regard to supporting and disseminating results from demonstration projects for sustainable building[3] (WGSC, 2004).

The demonstration project is emphasized as being a proven and effective tool for introducing and testing new policy (Sustainable Housing Policies in Europe, 2003 p. 19). The 'good example' is currently used both as a strategy and as a method for highlighting results achieved within the work for sustainable development (The Swedish Environmental Protection Agency, 2003; WGSC, 2004). Furthermore, the demonstration project is a method for innovation, development and knowledge build-up within the building sector (Miljövårdsberedningen, 2000; Rethinking Construction, 2002), and as exemplified in the following statement by the British project *Rethinking Construction*[4] (website http://www.rethinkingconstruction.org, January 2004):

[3] For example, through the projects: Thermie, SHINE, Expo Cities, RE-START, Green Cities, Meduca, CIVITAS, LIFE Urban etc. see website http://www.europa.eu.int/

[4] A joint partnership between United Kingdom clients, industry and government for a better building sector.

> The Demonstration Projects are at the heart of the Movement for Innovation and provide the seedbed where ideas and innovations are put to practical use and measured.

The practical experiment as method for innovation and knowledge build-up is intimately connected to the building practices (see for example Levón, 1986; Lundequist, 1995b; Linn, 1998). New ideas, technologies and concepts are tried out in practice, evaluated, and experiences and findings are diffused to the rest of the building sector. This practical-empirical method is the basis for the knowledge build-up within the building practices (Linn, 1998) being especially articulated in the building experiment and the demonstration project. The experience from the demonstration project will have an internal influence on the actors and organisations involved in the project as well as an external influence on the actors and parties outside the project organisation. The internal and the external influences are dependent on the diffusion of experience within the organisations involved in the demonstration project as well as the diffusion to the rest of the building sector and other interested parties.

The dissemination to mainstream building

The main aim for demonstration projects for sustainable building is to disseminate experience that will have an influence on mainstream building practices. The following example found in contemporary research on energy efficiency in buildings indicates the relatively small influence of demonstration projects on mainstream building. Despite contemporary political objectives and sector targets for reduced energy utilisation in the built environment, and despite the fact that energy efficiency in buildings can result in obvious advantages regarding economic savings, energy utilisation in new buildings has not radically decreased (Lovins, 1992; Lutzenhiser, 1994; Nässén and Holmberg, in press). As demonstrated by Nässén and Holmberg, contemporary demonstration projects for energy efficient housing have proved to result in reduced energy utilisation (Figure 1.1). However, as seen in Figure 1.1, mainstream building does not approach these lower levels of energy utilisation. Evidently there is a gap between good results from demonstration projects and what is diffused into mainstream building. Furthermore, Figure 1.1 shows that the energy utilisation in new multi-

residential housing in Sweden in later years even tends to exceed that of the housing stock in general. Accordingly, this also indicates a gap between contemporary ambitions for energy efficient and sustainable building and what has been built to date.

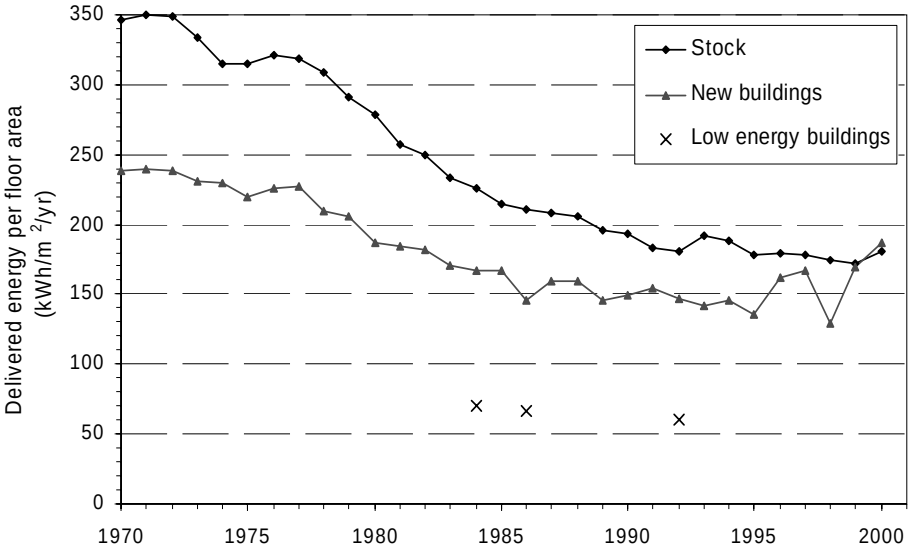


Figure 1.1 The efficiency gap between the development of delivered energy utilisation for floor heating per floor area of Swedish multi-residential buildings and a few examples of Swedish low-energy housing. The stock represents all heated area in a certain year. (Nässén and Holmberg, in press)

1.2 Aim and scope

The aim of this thesis is to contribute to an increased understanding of how demonstration projects for sustainable building can support and promote the further development of sustainable building. The two concepts, the demonstration project and the building experiment, are discussed as well as their potential for being able to influence mainstream building. The aim is to contribute to the understanding of the learning processes associated with demonstration projects for sustainable building.

Furthermore, the findings aim to provide a basis for the enhanced influence from future demonstration projects for sustainable building on mainstream building. Accordingly, the research deals with the particular

problems connected with sustainable building but that lie adjacent to general problems in contemporary building practices that show shortcomings in innovation and knowledge build-up (cf. Building for Growth, 1999; Construct for Excellence, 2001[5]; Rethinking Construction, 2002; Swedish Government 2002:115).

Target groups for the findings are found at different levels. On the one hand, those behind the project in the building sector are addressed, especially the key actors: the client and the architect. On the other hand, authorities (governmental and private[6]) as well as researchers are addressed as these are in position of being able to propagate for 'good' examples to their audiences in different ways and also promote new demonstration projects.

In addition, this thesis has the aim of contributing to advances in architectural research regarding developing ways of carrying out studies with an open research problem and also to develop ways of studying, understanding and presenting built examples. The built example has an important role in transmitting the practical knowledge of building practices (see Chapter 3). As emphasized by the architectural researcher Lundequist (1995a), an important role for architectural research is to continuously study and transmit experience carried out in practice. Architectural research should consequently evaluate and transfer experience and distribute practically based knowledge.

Methods and empirical material

The open-ended character of the research problem has directed the choice towards an *explorative* approach and the use of *qualitative* methods. An understanding of the research problem has been sought for in an iterative process between the findings from empirical material, existing theory and earlier research in the field. This understanding is based further on interpretations of sustainable development and sustainable building and against a background of the conditions of the

[5] Dulaimi et al. (2003) concerning these questions refer to: Building for Growth (1999*) An Analysis of the Australian Building and Construction Industries*. Industry Science Resources. Commonwealth. Australia, and Construct for Excellence (2001) *Report of the Construction Industry Review Committee*. January. SAR. Hong Kong.

[6] In Swedish: Branschorganisationer

practice in the building sector. A full description of the research approach, research design and methods used is found in Chapter 5.

The empirical material consists of studies in Sweden and the Netherlands, which provide different perspectives on demonstration projects for sustainable building. In all a total of four studies have been carried out using different methods for data collection and analysis.

The first perspective of demonstration projects is through two case studies. One case is GWL—terrein in Amsterdam, the Netherlands, and the other is a housing project at Lindholmen, in Göteborg, Sweden.

In the second perspective the demonstration project is approached through the view of the actors involved. In all, 27 actors in the Swedish and the Dutch building sector have been interviewed. Three categories of actors have been interviewed: architects, clients and environmental consultants. The respondents have been chosen for their involvement in demonstration projects in each respective country and through their position of having an active influence on the discourse about sustainable building, either as individuals or through the company in which they are employed.

The third and fourth perspectives study the demonstration project as portrayed by the Swedish trade press[7]. The third study focuses on the image conveyed from three influential Swedish demonstration projects from the later part of 1990s. The fourth perspective focuses specifically on the discourse on sustainable building in *The Swedish Architectural Review, Arkitektur*, between 1973 and 2002.

The scope

This thesis addresses *demonstrations projects for sustainable building*. The term and concept of sustainable building is still rather new for actors in the building sector, and remains largely unknown to the public at large. Also used by the Swedish building sector are other terms such as ‘ecological’ building or ‘environmentally adapted’ building parallel with the term ‘sustainable building’ with either similar or varying

[7] This study was carried out in co-operation with doctoral candidate Pernilla Gluch at the Department of Building Economy and Management at Chalmers University of Technology, partner of the former MISTRA Sustainable Building programme.

significations (see discussion in Chapter 7)[8]. Furthermore, contemporary ambitions for sustainable building have merged with earlier ambitions from the 1960s and 1970s for 'ecological' and energy efficient buildings (see Chapter 7). Environmental adaptation taking into account energy and resource efficiency, material utilisation, limitation of hazardous substances, etc. is one important part of the sustainable building concept. However, sustainable building involves other important factors of social, economic and cultural character. These are often expressed through consideration given to indoor climate, health, comfort, etc. at the individual level and economic growth and the sharing of resources at the collective and global level (see Chapter 2). The fact that demonstration projects for sustainable building constitute a rather new field with limited previous experience has led to the inclusion of earlier experience of the state of the art (Chapter 4) from demonstration projects and experiments in the building sector where main focus was on energy issues.

The thesis addresses demonstration projects in the building sector regarding activities at the *building level*. Furthermore, for the empirical studies, demonstration projects have been chosen in which the ambition has been to provide experience and knowledge applicable on a *broad scale*. Moreover, the demonstration projects in the empirical studies are all *housing* projects. The focus on housing can be explained by the limited number of cases of completed demonstration projects for sustainable building at the time when the doctoral studies were initiated. At the end of the 1990s there were still few demonstration projects for sustainable building in other areas than housing, which were of interest for this study. Consequently, the findings and the discussions in this thesis apply to *demonstration projects for sustainable housing*. In spite of this, the findings and discussions should also be of interest for issues about demonstration projects for sustainable building in other areas than housing.

Finally, the perspective is that of *Europe and the industrialized world*. In order to enlarge the Swedish national perspective, parallel

[8] As revealed through the interview study presented in Chapter 7, many actors in the Swedish and the Dutch building sectors interpret 'environmental adjustment' as a part of the wider sustainable building concept that also involves social and economic dimensions. Some respondents see 'ecological building' as an older and incorrect term, while some find the term more encompassing and human compared to the term sustainable building.

studies have been made of the situation in the Netherlands. The intensive development of sustainable building in the Netherlands in the middle of the 1990s explains the supplementary choice of the Dutch perspective. Since the early 1990s, the Netherlands has had political goals for the environmental adaptation of the built environment. Moreover, the Netherlands has a similar background to Sweden regarding activities in the environmental area. As in the case of Sweden, the Netherlands has had the ambition to play the role of environmental leader within the European Union and the United Nations (Haneberger et al., 2002 p. 39). The first and the second empirical studies mentioned above involve a supplementary perspective from the Netherlands, while the third and the fourth studies of the trade press are only carried out on in relation to the Swedish context.

Theoretical basis for analysis and discussion

Sustainable building as a research field within the architectural domain is still relatively new. There are no clearly defined frames of reference or theories to relate to. The theoretical basis in this thesis has been chosen in order to provide useful frameworks for the analysis and discussion of the findings from the empirical material. On a broad level, the demonstration project is discussed in relationship to the concepts sustainable development and sustainable building. Furthermore, theory has been selected from among other sources design theory, organisational theory, and innovation theory. Design theory and organisational theory are used to discuss the knowledge build-up and lessons from demonstration projects as well as how the experience should be presented in order to be useful. Together with innovation theory and a description of the routines and the organisation of work in the building sector, this theory also provides a basis for discussing the conditions for the diffusion of experience and findings from demonstration projects to mainstream building practices.

Moreover, the research has been inspired by discourse analysis for discussing the construction of meaning and the interpretation of the main concepts of demonstration projects and sustainable building, both among actors in the building sector and in the Swedish trade press.

1.3 Research questions

As already described the aim of this thesis is to contribute to an increased understanding of how demonstration projects can support and promote the development of sustainable building. On the one hand, the findings have a practically oriented aim at providing a basis for the enhanced outcome and influence from demonstration projects. On the other hand, the thesis has a scientific aim in order to contribute to advances in architectural research and to develop ways to approach an open research problem, and to study, understand and present built examples. From these aims, three specific research questions have been formulated:

1. *What is the importance of the demonstration projects for sustainable building to support sustainable development in the building sector?*

2. *How should demonstration projects for sustainable building be studied and presented in order to provide useful information for the target groups: the clients, architects, and/or other project owners*[9] *in new projects?*

3. *What are the conditions for diffusion and the reproduction of experience and findings from demonstration projects to mainstream building practices?*

1.4 Report structure and reading instructions

The thesis can be regarded as being comprised of three parts. The first part, Chapters 2 – 5, provides the background; the theoretical basis; the state of the art of the research field; as well as the research approach and methods used. The second part, Chapters 6 – 9, presents the four empirical studies. The third part is comprised of Chapter 10, which presents discussions, conclusions as well as the continued work.

[9] The term 'project owners' (in Swedish projektägare) is frequently at present (see for example on the Internet) but no definition of this could be found in any Swedish or British encyclopedia or dictionary. In this thesis the term is used to name the actor or group of actors responsible for the project with regard to initiation, financing and/or legal conditions.

Chapters 2 to 9 are concluded with summaries thereby providing a shortcut through the thesis. Consequently, after the introduction in Chapter 1, the reader can concentrate on the summaries and then move on to the discussions and conclusions in Chapter 10.

Chapter 1 provides an introduction to the research field, the research questions as well as the research approach.

Chapter 2 presents the concepts of sustainable development, ecological modernisation and sustainable building. It further presents strategies undertaken for sustainable development on a comprehensive level in Sweden, as well as the agendas for sustainable building in Sweden and in the Netherlands.

Chapter 3 firstly begins with a general description of the structure, routines and organisation of work in the building sector. This description is mainly based on the Swedish circumstances, but on a general level the implications for the development of sustainable building should be similar in the case of the Netherlands and other countries (cf. Hal, 2000; Rethinking Construction, 2002). Secondly, theories from the research fields-dealing with design, organisation, and innovation are presented to provide a framework for a discussion about conditions for knowledge build-up, learning, innovation and development in the building sector.

In Chapter 4, earlier studies of experience and influence from building experiments and demonstration projects are presented. Derivations are made regarding the terms building experiment and demonstration project based on their application. Furthermore, earlier experience of disseminating results from building experiments and demonstration projects to mainstream building practices are discussed.

Chapter 5 presents the research approach, the methodological approach and the research design. This chapter also introduces a discourse analytical perspective on the empirical material. Moreover, the four empirical studies are introduced together with a description of the specific methods used for data collection and analysis for each of the studies.

Chapter 6 presents the first empirical study, comprising of two case studies of demonstration projects for sustainable building. The cases are described, both in terms of the product and the process, and through the image conveyed by project owners and the media. An analysis is made of each case. The findings from both cases are then brought together

providing specific lessons from the cases, in addition to a general discussion on the value of demonstration projects. The discussion also addresses ways of studying and presenting experience from demonstration projects.

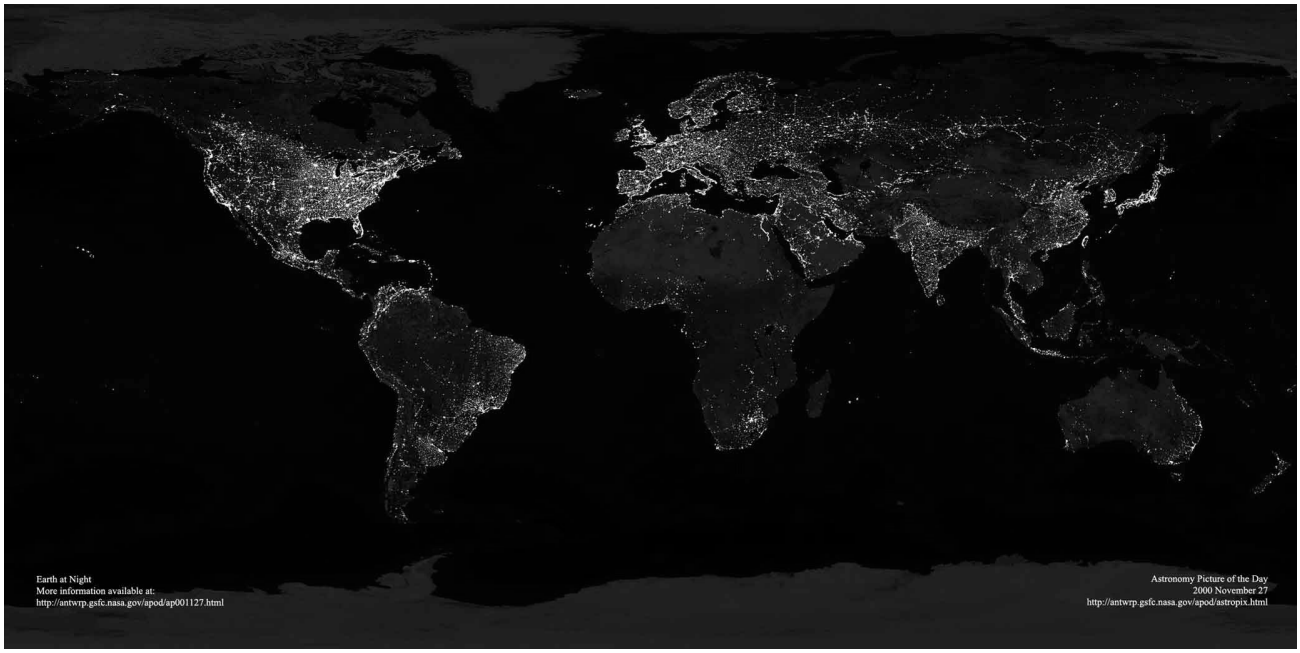
Chapter 7 presents the second empirical study, an interview study with 27 actors in the Swedish and the Dutch building sectors. The actors have been chosen with regard to their active involvement in sustainable building, and from their position as opinion leaders in the field. The findings presents the actors' current view on the development of sustainable building, their personal interpretations of sustainable building and their approach to working with these questions in practice. Furthermore, the interview study reflects the respondent's views on demonstration projects.

Chapter 8 presents the third empirical study, a study of the Swedish trade press. The image portrayed in the trade press of three well-known Swedish demonstration projects is studied using mainly textual analysis and content analysis. The aim here has been to answer the following questions: what is the image conveyed about demonstration projects for sustainable building and what information is given? Also, does the trade press fulfil the role as a communicator of information about demonstration projects and sustainable building?

Chapter 9 presents the fourth study, a study of *The Swedish Architectural Review, Arkitektur*. The architectural press is of prime importance for presenting good examples and must be seen as having a large influence on architects as a professional group. Architects that are in favour of sustainable building as well as advocating good examples of sustainable building fulfil important roles as opinion leaders for the rest of the building sector and the general public. This study discusses how sustainable building has been debated in *Arkitektur* during the period 1973 – 2002.

Finally, *Chapter 10* discusses the relevance and the effectiveness of demonstration projects as a strategy for making mainstream building more sustainable. Based on the findings from the empirical studies, weaknesses in contemporary demonstration projects with regard to knowledge build-up, learning and the reproduction of results are discussed. An enhanced model for demonstration projects is proposed through incremental and successive development. The chapter also

discusses the power of the example and the influence of information and images about demonstration projects for sustainable building that by among other means are spread via the trade press. The chapter is ended with some concluding comments and proposals for continued work in the field.



Picture 2.1 Visualizing unsustainable development. Satellite photo Nasa November 2000.

There are other things (in life) than subscribing to the feeling of one's own inadequacy. If we can't afford a more beautiful vision of the world – then who can? Every day people die from starvation so that we can keep up our material standards. Are they doing this in vain? Do we feel even half as free/rich as we really are? We are privileged. I find it hard to believe that we have ended up in the richest part of the world just to invent sudden adult death, walk in to a multitude of walls and then wonder how we can feel so empty inside even though we've been so creative. I've met several people wondering about that. The revolution has become mainstream. Possibly that's our only salvation. Because there is an us.[10]

Bob Hansson, poet, In *Här ligger jag och duger*, W&W 2002

[10] Det finns andra grejer att prenumerera på än känslan av sin egen otillräcklighet. Om inte vi har råd med en vackrare vision av världen – så vem då? Folk svälter dagligen ihjäl för vår materiella standard. Gör dom det i onödan? Känner vi oss ens hälften så fria/rika som vi är? Vi är priviligerade. Jag har svårt att tänka mig att vi hamnat i världens rikaste del bara för att uppfinna plötslig vuxendöd, gå in i en massa väggar och sedan undra hur det kan kännas så tomt fast vi varit så kreativa. Jag har träffat fler som undrar det. Revolutionen håller på att bli mainstream. Möjligen är det vår enda räddning. För det finns ett vi.

Chapter 2 Sustainable Development and Sustainable Building

This chapter presents the concepts of sustainable development and sustainable building, i.e. sustainable development concerning building activities and the built environment. The chapter begins with a description of contemporary problems regarding the environment and development. The notion of sustainable development is discussed from the view of mainstream sustainable development and ecological modernisation, what must be seen as the dominating view in Sweden and many other countries in the industrialised world. The chapter also presents investments in Sweden regarding sustainable development on a political level as well as the Swedish and the Dutch national agendas for sustainable building.

2.1 Contemporary problems of environment and development

The state of the world at the beginning of the 21st Century gives witness to an unsustainable development characterized by a growing population, increasing consumption and unequal distribution of resources[11]. The growing population as well as the modern western lifestyle involves large burden on the natural environment that in our time has resulted in climatic changes, holes in the ozone layer, loss of species and natural habitats etc. (see for example, Starke, 2003, Starke 2004).

Many contemporary environmental problems are characterized by an increased complexity. Environmental problems are often concealed in mechanisms, structures and organisms and their effect scan be delayed long after the actual discharge (Figure 2.2). New organisms and

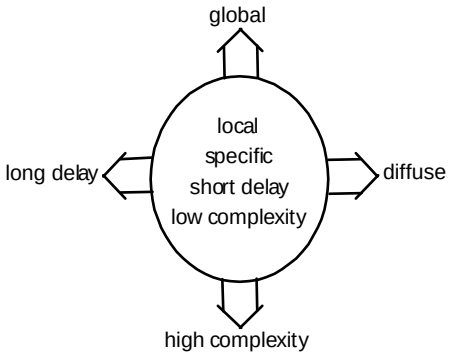


Figure 2.2 The changing character of environmental problems (drawing based on lecture by Professor Emin Tengström at Chalmers University January 14th 1999)

[11] About 15% of the world population at present uses 80% of the resources (Miljövårdsberedningen, 2000).

chemicals, which have never existed before, are today brought into the societal and natural metabolism (Holmberg, 1995). These technological and scientific artefacts are introduced without any certainty of their long-term effects on either humans or nature.

Many environmental problems, especially in the western world, are further characterized by their lack of 'sensuousness'. We need the 'prolonged senses' of scientific methods and instruments to reveal them. Beck (1992) has thoroughly described the risks in contemporary society and points out environmental problems as being dependent on science. The recognition of an environmental problem is thus a matter of interpretation dependent on scientific methods and instruments, as well as political, cultural and social value systems (ibid). Furthermore, technological risk in contemporary society is characterized by being capable of transcending generations and by exceeding the capacity of current mechanisms for compensating victims (Beck, 1992).

Andersson and Molander (1995) argue that an environmental problem can be defined as a human caused (anthropogenic) effect on an ecological system that is regarded as a problem. Environmental equilibrium can be preserved as long as the environmental system is kept within the limits of self-regulation (Edman, 1998). When the limit is reached and nature gets out of balance we will have serious problems. In their extreme, environmental problems can be defined as 'the wrong quantity at the wrong place' (Lidskog et al., 1997).

2.2 Sustainable development

Sustainable development has become one of the most prominent phrases in the development discourse since the United Nations Conference on Environment and Development (UNCED or 'Earth Summit') in Rio 1992 (Adams, 2001 p. 1-2). Behind the concept lies, on the one hand, strives to solve environmental problems, the science of ecology and concern for nature preservation mainly in the Western world, and on the other hand, the development and poverty problems of the Third World (Adams, 2001 p. 51).

Among other instances, sustainable development has been codified through the *World Conservation Strategy* (WCS) prepared by the International Union for the Conservation of Nature (IUCN) in 1980. It

was then further developed through the report of The United Nations World Commission on Environment and Development (WCED), *Our Common Future* in 1987, and the follow up to the WCS, *Caring for the Earth* in 1991 (Adams, 2001). In 1992, the concept became widely known through the *Agenda 21* and the Rio Conference. According to Adams (2001), although different the mentioned documents have a remarkably consistent core of ideas - a 'mainstream' strongly influenced by science, ideas about wildlife conservation, concerns about multi-lateral global economic relations and emphasis on the rational management of resources to maximise human welfare.

Mainstream Sustainable Development

One of the key events in the emergence of the concept of sustainable development was the United Nations Conference on the Human Environment held in Stockholm in 1972 (Adams, 2001 p. 54 – 57). At this conference many of the Third World countries insisted on the fact that long-term environmental protection should not hinder economic growth to resolve urgent short-term problems, such as poverty, hunger and disease. Attempts to address the problems of the Third World set forward that environment and development should be seen as an integrated whole, and that development should not be impaired by environmental protection.

As a result of the Stockholm conference the United Nations Environmental Programme (UNEP) was created. The UNEP commissioned the IUCN to prepare a document that would become the *World Conservation Strategy*. The *World Conservation Strategy* contributed to the diffusion of the term 'sustainable development'. However, the view in this document is mainly environmentalist and theoretical. Consequently it failed to involve ideas about economics and politics, which are fundamental to the development process (Adams, 2001 p. 59 – 69).

The United Nations World Commission on Environment and Development presented in 1987 their report *Our Common Future* (also known as The Brundtland report). This report placed sustainable development within the economic and political context of international development, thus returning to the ideas of the conference in Stockholm

1972 (Adams, 2001 p. 70). In *Our Common Future* (WCED, 1987) sustainable development is defined as:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs' in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

The Brundtland definition, according to Adams (2001 p. 71), is based on two concepts: the basic needs for the poor and the idea of environmental limits from impact from the human society. These limits are not however set by the environment, but by technology and social organisation. This meant an important change from the ecologically based concept of sustainable development to the socio-economic context (ibid). So though the answers in *Our Common Future* were similar to the ones proposed by the *World Conservation Strategy*, The World Commission on Environment and Development was far more effective in their ability to address and engage government policy-makers.

Important ingredients in the sustainable development proposed by the Brundtland report were the concern for basic needs, to merge environment and economics and the focus on economic growth as one important way to tackle poverty as well as environmental and development objectives (Adams, 2001 p. 72). The basis for these ideas is mainly found in theories of market economy and not in concern for the environment. The overall assessment is that the international economy should speed up growth and development on a global level while respecting environmental constraints. However, according to Adams, the Brundtland report did not mention how this should be done.

The Earth Summit in Rio 1992

The World Commission on Environment and Development, and their report *Our common future,* played a major role in the United Nations Conference on Environment and Development in Rio 1992. The conference experienced tension between Northern and Southern governments, and the outcomes can be seen as compromises to satisfy the needs for all parties (Adams, 2001 p. 83). One important outcome

from the Rio Conference was the *Agenda 21,* a vast document with a large scope from water quality to the role of women and children in sustainable development. As in its predecessors, *Agenda 21* depends on economic growth both globally and nationally. The view, according to Adams (2001 p. 88), is techno-centrist; it is built on information, science and environmentally sound technology. *Agenda 21* calls for sustainable development through public participation, but according to Adams (2001 p. 89) ”like its predecessors, it is much stronger on hopeful sentiments about involvement than political analysis on power”.

Doubts have been raised concerning the significance of the achievements from Rio and *Agenda 21*. Many of the problems addressed in *Agenda 21* have become worse, for example, poverty and the gap between rich and poor countries (Brown, 1997 quoted in Adams, 2001 p. 95). In that sense Rio did little to promote sustainable development as such, however, it opened the debate about choices in development. One main factor for failure is that the financial support necessary to implement *Agenda 21* was not stimulated (Adams, 2001 p. 96). Others see hope for real change in the backwater of Rio (Murphy and Bendell, 1997, quoted in Adams, 2001 p. 98). Sustainable development can be seen as ”a new organising principle” and potential to join diverse and often-competing ideas.

2.3 Ecological modernisation

According to Adams (2001), the mainstream sustainable development developed through the Rio conference is based on a free market, the continuation of growth and on the application of technology. Mainstream sustainable development shares the dominant ideas of modernisation and economic growth in the modern world, and does not suggest any fundamental or radical changes. The fact that mainstream sustainable development has been within reach of conventional tools and environmental and market regulation has contributed to the persuasion of governments all over the world (Adams, 2001 p. 104). Moreover, mainstream sustainable development offers good opportunities for the market of clean technologies. However, there also exist counter currents in the sustainable development discourse, such as Green critics of developmentalism, Eco-socialism, Eco-anarchism, Eco-feminism etc.

Alternative ideas were also presented at Rio in 1992, although these counter currents did not find favour among the negotiators (Adams, 2001 p. 141).

Adams identifies three important groupings of thought within the idea of mainstream sustainable development: *market environmentalism, environmental populism* and *ecological modernisation* (ibid). Market environmentalism is based on continued capitalist growth, and therefore in strong opposition to ideas of 'zero growth' and 'limits to growth', prominent ideas of the 1970s. As stated by Adams (2001 p. 110), it is quite literally 'business as usual'. Environmental populism is based on the participation by ordinary people in decision-making (Adams, 2001 p 114-115). This idea is based on the voluntary cooperation in a process in which people have has the possibility to intervene.

Ecological modernisation, with its root in the 1980s, combines economic growth with environmental improvement without implying any derivation from the path of modernism (Cohen, 1997; Adams, 2001; Fudge and Rowe, 2001; Anshelm, 2002). Ecological modernisation is techno-centrist in its pursuits of rational, 'clean' technological solutions to environmental problems and more efficient institutions for environmental management and control. Ecological modernisation is based on a belief in science to solve human and environmental problems and dependent on governmental regulations to promote innovation in environmental technology. Consequently, environmental protection is not seen as a burden on the national economy but instead a source for future growth, mainly in western countries. Discussions on eco-efficiency and 'factor 10'[12] are in line with ecological modernisation (Falkheden, 1999 p. 54).

Ecological modernisation is also built on the principle that institutions can change, and that actors within them can learn, on a shift in values and a wider 'greening of society' (Adams, 2001 p 114 – 115), at the same time (Adams, 2100 p. 112). It can be seen as a necessary stage in a process of industrial transformation (Cristoff 1996, quoted in Adams, 2001 p. 13). Sweden and the Netherlands are two nations in the industrialised world that have entered the path of ecological

[12] The idea behind the concept of factor 10 etc. is that industrialized countries should within one to two generations render their use of resources and decrease their total impact on nature by 10 times, maintaining or increasing contemporary living standards. The concept has been developed by the Wuppertal institute (see, Swedish Government 1998/99:5).

modernisation (Cohen, 1997 p. 114; Adams, 2001 p. 12; Fudge and Rowe, 2001 p. 1528).

Ecological modernisation is in many ways contradictory to the risk society perspective established by Beck (Cohen, 1997). Beck is sceptical and even negative to the possible contribution of science and technology to mastering environmental problems. Beck points out the threats of technology due to their failure to develop effective institutional control and the limits of a reductionist science.

Weak and strong ecological modernisation

Fudge and Rowe (2001) refer to a development or maturation of the concept of ecological modernisation, where the early focus on technological innovations, the state and the market has turned to focus on socio-economic and institutional and cultural dynamics.

Cristoff (1996, quoted in Adams, 2001 p. 141) identifies several differing and sometimes conflicting versions of ecological modernisation. He distinguishes 'weak' ecological modernisation, which is 'economistic', technicalogically narrow and national, from 'strong' ecological modernisation that is ecological, systematic and international (Table 2.3).

Table 2.3 Weak and strong ecological modernisation (adapted after Cristoff 1996 quoted in Adams 2001 p. 141)

Strong ecological modernisation	Weak ecological modernisation
Ecological	Economistic
Institutional/systematic (broad)	Technological (narrow)
Communicative	Instrumental
Deliberative democratic (open)	Technocratic (closed)
International	National
Diversifying	Unitary

Similar reasoning can be found in Jensen (1994 quoted in Falkheden, 1999 p 103). Jensen finds that contemporary demands for sustainable development have lead to two differing strategies for planning and building. On the one hand, *urban ecology* can be seen as efforts to solve *all* environmental tasks in *one* locality. On the other hand, *environmental management* can be seen as efforts made to solve *one* environmental task in *all* places (Table 2.4). Parallels can also be drawn

to the metaphor of two strategies for sustainable development proposed by The Swedish Environmental Protection Agency (1998). In their scenarios for Sweden in 2021 they distinguish between two strategies: the 'path-finder' strategy with small-scale local solutions and a large divergence in solutions, and the 'way-winner' strategy using large-scale solutions applicable in a broad perspective.

Table 2.4 Urban ecology and environmental management as different strategies for sustainable development regarding planning and building (Based on Falkheden, 1999 and Edén et al. eds 2000, based on Jensen 1994).

URBAN ECOLOGY	ENVIRONMENTAL MANAGEMENT
All environmental tasks in one locality	One environmental task in all localities
Offensive measures	Defensive measures
Urban planning	Public measures
Design	Implementation of new techniques
Small scale	Large scale
Interdisciplinary development	Economy and legislation
Education/training	Administration/information
Practical experiments	Demonstration projects
Grass-roots activity	Civic involvement
Cultural development	Social experiments

2.4 Operational models for sustainable development

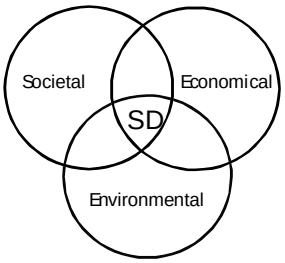


Figure 2.5 Basic notion of sustainable development comprising of three dimensions.

In the Brundtland Report, as well as in earlier documents that set the direction for sustainable development, little was said as to how sustainable development should be accomplished. When moving from an ethical and visionary level of sustainable development to an operational level we need further developed models.

The basic notion of sustainable development is often illustrated by a simple three-circle diagram (see Figure 2.5). Sustainable development is achieved when the three dimensions: economic, environmental and social coincide or overlap. Although informative, this static representation can distract us from the original complex vision of sustainable development (see more Edén et al., 2000). Other parts, outside sustainable development, can be seen as legitimated, competing, unsustainable, political and scientific areas. Furthermore, the model opens up for the possibilities to distinguish, for example, 'economic sustainability' or 'environmental Researchers at the German Wuppertal

Institute have developed a four dimensional conceptual model, 'the prism of sustainability', for the operationalisation of sustainable development (Valetin and Spangenberg, 2000). Here the notion of sustainable development has been increased with a fourth dimension or imperative, the institutional. The institutional imperative refers to the societal and individual capacity to handle information, knowledge build-up and development. It further involves public participation, democracy and regulation. The prism model has the advantage in representing a space in which the issue of sustainable development can be approached from any dimension. Shortcomings in the Wuppertal prism are the choice of dimensions. Kain (2003 p. 326) argues that the economic notion in most conceptualisations of sustainable development is not useful since it *'celebrates a confusion between human-made capital, market system, and financial and monetary assets.'* Further the difficulties in distinguishing between the concept of social capital[13] and the notion social in general make the Wuppertal prism vulnerable for interpretations. Kain has further developed the prism into the MAIN^{tetra} (Figure 2.6) the dimensions: mind, artefact, institution and nature (2003 p. 327).

The MAIN^{tetra} can be rotated and flipped in any direction putting the issue in hand at the top. The MAIN^{tetra} is scale-less, or applicable to all scales, does not refer to any time-scale and mainly supports operationalisations on a local level. The MAIN^{tetra} has several advantages to the Wuppertal prism in conceptualising sustainable building. The articulation of the artefact is important and congenial to architects and planners in clarifying cultural values that otherwise can be difficult to manifest. The replacement of 'environment' for 'nature' makes it easier to point to the values of nature in itself.

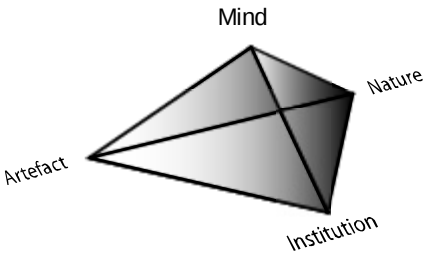


Figure 2.6 The MAIN^{tetra}- Mind-Atrefact-Institution-Nature, a model for the dynamic understanding of sustainable development (after Kain, 2003 p. 326).

Mind – ethics, world-view, knowledge, skills and other human attributes

Artefact – works of art, instruments, machines, buildings and physical networks

Institution – formal and informal relation webs of all sizes and directions, formal and informal norms, information systems and codified knowledge

Nature – all kinds of natural elements from the ecosphere and the lithosphere

2.5 Sustainable building

Sustainable development in relation to building activities and the built environment is often called sustainable building or sustainable

[13] The four different forms of capital used by the World Bank, i.e. human, social, natural and human-made (see, www-esd.worldbank.org). In the MAIN^{tetra} these have been replaced by: mind replacing the human capital, artefact replacing the human-made capital, institution replacing the social capital, and nature replacing the natural capital (Kain, 2003 p. 327).

construction. The building sector is one of the largest societal and economic sectors in Europe (CIB, 1999), and together with the built environment contributes significantly to the pressure on the natural environmental. The building sector and the built environment have been pointed out as two key areas of concern for global sustainable development (CIB, 1999; Miljövårdsberedningen, 2000).

There does not exist any unique or single internationally accepted definition or recommendation for sustainable building (CIB, 1999; WGSC, 2004). As pointed out by The European Working Group Sustainable Construction Methods & Techniques (in this thesis called by the abbreviation WGSC), and The International Council for Building Research, CIB, short common definitions are not possible due to local conditions and constraints, specific features and national and cultural priorities.

The setting of an agenda for sustainable building is a task that occupies national governments, the European Union, as well as the research community and the national building sectors in many countries around the world. The International Initiative for a Sustainable Built Environment, iiSBE, and the Green Building Challenge[14], the GBC, are examples of international organisations that work with international exchange and cooperation regarding knowledge build-up on sustainable building.

The buildings and the environment

While the characteristics of sustainable building demand more effort to be determined in figures, the unsustainable features of contemporary western building practices are easier to describe: The building sector in the European Union is attributed with more than 40% of the total energy use, 30% of the CO_2 emissions, and is estimated to generate 40% of all man-made waste (CIB, 1999). Buildings and building activities affect the environment through the use of resources, the use of land and through emissions. Large amounts of resources in the form of materials, energy etc. flow through the building sector. Furthermore, the built environment contributes to the global degradation of nature, such as the devastation of forests, the degradation of fresh water, the continuous

[14] See website: http://www.greenbuilding.ca for more information about iiSBE and GBC.

exhaustion of natural capital resources such as gravel etc. The WGSC (2004 p. 11) points out figures estimating that the building sector accounts for approximately 50% by weight of all the materials taken from the earth's crust (also natural and non-renewable) and that these are being depleted beyond sustainable levels.

The interaction between the built environment and nature is highly complex. Buildings have a relatively long lifespan compared with other artefacts, and will have an impact through all stages from planning, construction, utilisation, and demolition or reuse. A building is a complex product involving a range of materials and compounds that will interact. In addition, buildings have a considerable effect on human health. For example, in Europe people spend 90% of the time indoors (Miljövårdsberedningen, 2000; WGSC, 2004). The lifespan of a building can average 100 years, the initial costs, equivalent to 7 to 20 years running costs, are thus relatively small (WGSC, 2004 p 11). In Sweden, research has claimed that up to 85% of the energy use is allocated to the operational and user phase (Adalberth, 1997).

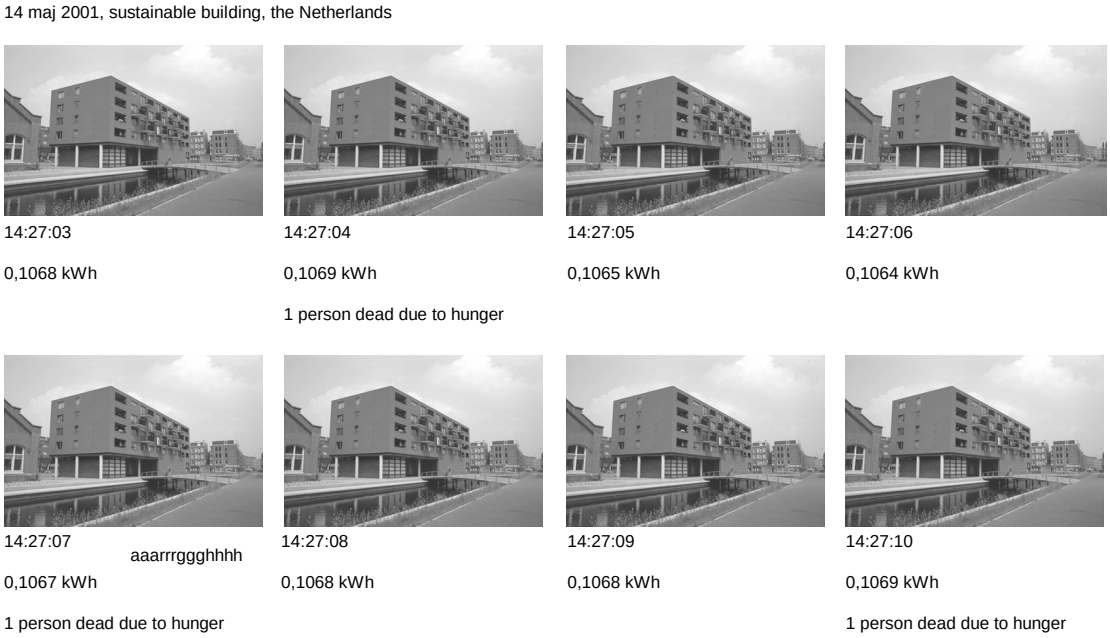


Figure 2.7 Image of sustainable building made by the author.

Basic features in sustainable building

Sustainable building is often considered as confronting two challenges (see for example Buijs and Silevster, 1996): On the one hand, the interrelation between buildings and building activities, resource use and environmental impact has to be determined and objectives have to be set up. On the other hand, these objectives have to be implemented in the fragmented and complex building sector (see Chapter 3). The challenge with sustainable building concerns an integrated solution for environmental consideration, at the same time as attaining levels of quality of life, comfort, social, economic, cultural values (WGSC, 2004).

In general, a life-cycle approach is advocated when addressing sustainable building, including the whole cycle of construction from planning to demolition. Moreover, the joint efforts among all the actors involved in the building sector from material producers to end-user are considered important (CIB, 1999; Miljövårdsberedningen, 2000; WGSC, 2004). Some of the main overall objectives for sustainable buildings are: energy efficiency, reduction in use of resources that cannot be replenished, reduction of waste, reduction of fresh water utilisation, rejection of hazardous substances, minimisation of the impact on bio-diversity, and the quality of the indoor climate (CIB, 1999; Miljövårdsberedningen, 2000; WGSC, 2004). Even though the building design is influential, main performance parameters for sustainable building are usually considered as being decided upon at the urban policy and planning level (cf. WGSC, 2004). The WGSC (2004 p. 13) emphasizes that sustainable building is performance based and independent from any architectural style.

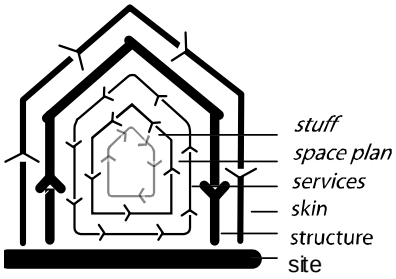


Figure 2.8 Shearing layers of change in a building (after Brandt, 1994 p. 13 built on Duffy).

Several authors propose a systemic approach to sustainable building interlinking the different components, materials and functions of the buildings (Brand, 1994; Cole and Lafreniere, 1997; Edén et al., 2003; Thuvander, 2004). Based on ideas by Duffy, Brand has created a time model for different layers in a building (Figure 2.8). The site has the slowest change cycle and interior material (called 'stuff' in Brand's model), the quickest. Layers with a quicker life-cycle span should be designed for change[15] (Brand, 1994 p. 17). Cole and Lafreniere (1997)

[15] Brandt refers to the biologist O'Neill (1986), who through studying ecosystems came to the conclusion that *"The dynamics of the system will be dominated by the slow components, with the rapid components simply following along".*

have further developed the ideas of Duffy and Brand into a framework for environmental design referring to three different scales. The temporal framework establishes an order between materials and components regarding lifespan. The scale-based framework refers to system boundaries in space, such as the building, the site, the neighbourhood, the city etc. (Fig. 2.9). The contextual circumstances are the most open-ended framework that refers to the physical environment as well as to politics, financial systems, cultural aspects etc. Furthermore, adaptability and flexibility are often mentioned as key words in sustainable building (Brand, 1994; WGSC, 2004).

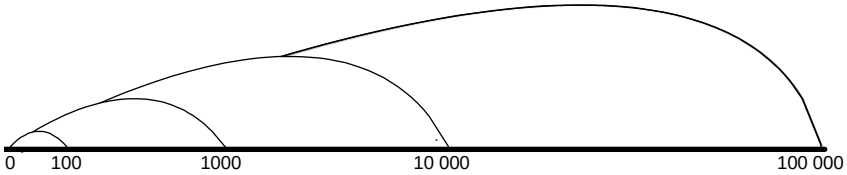


Figure 2.9 Space scale: building, building site, neighbourhood, area, city, region etc.

The contemporary building process[16] is characterized by being largely fragmented, with many different actors having different cultural backgrounds, tasks and responsibilities that render the implementation of sustainable building more difficult (see Chapter 3). For the individual actor the consideration for sustainable building will be fragmented and will concur with other interest, obligations and values in everyday practice. The importance of co-operation for achieving sustainable building and the need of an *Integrated Design Process* has often been underlined (see for example CIB, 1999; WGSC, 2004). Some factors for an enhanced Integrated Design Process (IDP) are: inter-disciplinary co-operation among actors, common objectives, consensus on performance issues, a *design facilitator* or *process champion* etc. (Larsson, 2000; Wallin, 2002). The design facilitator or process champion has the task of safeguarding the issues of sustainable building through the whole process and to provide specialist knowledge in the field.

Falkheden (1999; in prep) emphasizes on an additional value of the built environment in supporting processes of change towards sustainable development: In enabling connections amongst people, between people

and nature and in creating links between the local context and global processes (see also, Örneblad, 1997). Such *designed links* visualize the interactions between the human and the natural systems and give concrete feedback between actions and environmental consequences through daily use (Falkheden, 1999). They advocate the tangible and sensuous, to counteract the intangible and non-sensuous environmental and sustainable problems. Thus, the built environment can be given a more active, supportive and transformation promoting role. An example of such a designed link is a local bio-cleaning system for water and wastewater in Kolding, Denmark (Picture 2.10).

Picture 2.10 The local bio cleaning system is accomodated in a glass pyramid in the centre of the residential area of Kolding, Denmark. One of the tenants said the following about the relevance of this feature: *"It is so tangible – so that everyday I am met with something that reminds me of ecology and the environment"*[17]. The daily, obvious, and manifested reminds people of the interrelation between humans and nature (Falkheden, 1999). (Photo by Lena Falkheden)

[16] The term building process is used here to include the planning, design and construction of a building.
[17] "Det er så synligt – så jeg hver dag bliver mødt med noget der får mig til at tænke på økologi og miljø." (Falkheden, 1999, p. 211)

2.6 The Swedish approach to sustainable development and sustainable building

In his 1996 statement of government policy, the Swedish Prime Minister, Göran Persson, stated (Swedish Government, 1997/1998:13):

> Sweden should be a driving force and a model when it comes to efforts to achieve ecological sustainability.

In this first national policy document for sustainable development from 1997, the ecological and environmental dimensions were emphasized and the official term was 'ecological sustainability. Actions over the last years have increasingly encompassed financial, social, employment, educational, and cultural measures (Swedish Government, 2000:52; Swedish Government, 2001/02:172).

The Commission on Ecologically Sustainable Development appointed by the government in January 1997, set up three headline objectives for Sweden (Swedish Government 1997/1998:13): *protection of the environment* (environmental impact should not exceed nature's capacity), *sustainable supply* (long-term productivity and conservation of forests, land, and water resources/use of raw materials able to be relenished), and *efficient resource utilisation* (regarding energy and natural resources). Based on these three headlines, *15 national objectives for environmental quality* were proposed and approved by the Swedish Parliament in April 1999 (Swedish Government, 1997/1998:145). The 15 national objectives[18] point out the direction to take and what should be achieved within a generation (Table 2.11). Objective number 15: *A good urban environment* is especially addressed to the building sector and the built environment. However, building activities are also affected directly or indirectly by several of the other objectives, in particular numbers 1, 2, 4, 5, 6, 7, 9 and 12.

In January 1999, a new Swedish *Environmental Code* came into force. This new law states that consideration for the sustainable resource efficiency with regard to land and water and of energy and natural resources should be taken in all planning and building activities. The

1	Reduced climate impact
2	Clean air
3	Natural acidification only
4	A non-toxic environment
5	A protective ozone layer
6	A safe radiation environment
7	Zero eutrophication
8	Flourishing lakes and streams
9	Good quality ground-water
10	A balanced marine environment flourishing coastal areas and archipelagos
11	Thriving wetlands
12	Sustainable forests
13	A varied agricultural landscape
14	A magnificent mountain landscape
15	A good urban environment

Table 2.11 The 15 Swedish national objectives for environmental quality as restructured and developed in Swedish Government 2000/01:130.

[18] An additional 16th objective on biodiversity should be included at the latest by 2005 (Swedish Government 2001/02:172).

1	The future environment
2	Limitation - the climate changes
3	Population and health
4	Social unity, welfare, and safety
5	Occupation and learning in a knowledge society
6	Economic growth and competitiveness
7	Regional development and unity
8	Planning

Table 2.12 The eight strategic areas for major concern in the Swedish national strategy for sustainable development (Swedish Government 2001/02:172).

'best available technique' should be used. However, the technique is not defined and should continuously be developed (Miljövårdsberedningen, 2000). From a societal point of view, the law emphasizes that a good living environment should be created. The law should ensure a good environment for current and future generations[19]. It gives nature its proper value of protection, not only as part of the human living space.

As part of the Swedish Government's work with sustainable development, a *National Strategy for Sustainable Development* has been formulated (Swedish Government, 2001/02:172). The national strategy is based on already established objectives and decisions and will be a basis for the continued work. The national strategy provides long-tem visions and values, instruments, tools and processes necessary for the development. Even if it is mainly national, the strategy has an international and global perspective. The objectives will be approached via different instruments: legislation, planning, co-operation and integration between societal sectors, economic instruments, indicators, research and development, education and information etc. The Swedish Government has pointed out eight strategic areas of major concern (Table 2.12). The building sector is directly or indirectly concerned with strategic area numbers 1, 2, 5, 6, and 7, but mainly concerned with number 8 about *Social structure*. This strategic area is closely linked to the national objectives for environmental quality; *A good urban environment*. Objectives for the area are: a good living environment, good technique and system solutions and environmentally adapted building and effective management. The focus is on energy efficiency, but also on a good environment satisfying comfort, healthy indoor climate, resource efficiency etc. The national strategy emphasizes the value of our cultural heritage as a resource. At the end of last year a special secretariat for sustainable development was established for the Cabinet Offices and the Ministries (Cabinet Office, 2003). The secretariat will have the function of integrating the work with sustainable development between the Ministries. Furthermore, it has the

[19] Information collected from The Environmental Code education homepage. Five basic headlines support the law: Human health, Valuable natural and cultural environments are to be protected and conserved, Biological diversity is to be preserved, Long-term good management of resources should be secured, and Reuse and recycling should be supported. Webpage: http://www.miljobalksutbildningen.gov.se, and the Environmental Protection Agency webpage: http://www.environ.se

task of developing the national strategy and international action in environmental and sustainability questions.

The agenda for sustainable building

In Sweden no national definition of sustainable building has been spread. The environmental impacts of activities in the building sector and the built environment have been discussed together with agendas formulated by governmental organisations and by the building sector.

The work by a large number of governmental agencies to concretise the 15 national objectives for environmental quality into sub-objectives and sector specific objectives was presented in the summer 2000 (Swedish Government, 2000:52). The Swedish National Board of Housing, Building and Planning, Boverket, has the main task of concretising number 15 of the national objectives for environmental quality: *A good urban environment.* Boverket has proposed a number of sub-objectives (Boverket, 1999a) and sector specific goals (Boverket, 1999b). The sector specific objectives focus on four main areas: energy efficiency, improved indoor climate, resource management, education in the sector as well as the use of environmental management. In order to achieve objectives for energy efficiency, bought-in energy should be limited to 60 kWh/m^2 in new buildings by 2020. In public buildings, a 50% reduction of bought-in energy should be achieved by 2050. Regarding indoor climate, humans should not be exposed to emissions, bad ventilation, noise, dampness, radon or electrical and magnetic fields. Research and experiments should certify a reduction in health related problems in buildings. By 2020, no negative health effects from known chemicals should be found. To achieve the objectives for resource management, the use of raw materials and water should not exceed the capacity of each area. Waste volumes and disposal from building and engineering works should decrease and reuse and recycling increase. All standards, documents, organisations and administrations within the building sector should have an increased environmental and eco-cycle perspective. In this way, all actors within the sector should gain knowledge in the field.

The Eco-cycle Council for the Building Sector[20] is a voluntary organisation with representatives from a large range of actors within the building sector (clients, property owners, architects, technical consultants, contractors and building material producers). The Eco-cycle council works on a voluntary basis to set up an agenda and an action programme for the building sector. As a result of a survey from 2000 (The Eco-cycle Council for the Building Sector, 2000), four main areas of concern for sustainable building were detected: reduced energy use, reduced waste disposal, reduction of unwanted substances in building and engineering works, and a good indoor environment. In an environmental programme published in 2003, the Eco-cycle Council for the Building Sector (2003) has set up objectives to be fulfilled within a single generation. Within one generation the sector should have reached a considerable reduction in energy use and an almost total stop in the use of fossil fuels. Furthermore a considerable reduction should have been attained regarding the exploitation of virgin land. Buildings should be designed to be flexible and with good quality for a long period of utilisation. The buildings should be designed from a life-cycle perspective in order to reduce the use of materials, to increase reuse and recycling and minimize building waste and disposal. The unwanted substances in building materials should be at a minimum level and hazardous waste handled correctly. The building material industry should be encouraged to provide extended information about materials. The building industry should use materials with the lowest environmental impact. The ambition is that within a single generation, all buildings should as a matter of course provide a good healthy indoor environment. That is to say, it should be free from dampness, provide good sound reduction and good natural lighting as well as good thermal insulation. This, the environmental programme of the Eco-cycle Council for the Building Sector, should be systematically updated and revised to achieve a gradual progress of improvement in the building sector.

The Environmental Advisory Council[21] for the Swedish Government has invited 20 of the leading companies in the building sector and three municipalities to a dialogue called Building/Living.[22] The result from this unprejudiced dialogue is a vision and a strategy for a sustainable

[20] Byggsektorns Kretsloppsråd, website http: www.kretsloppsradet.com
[21] In Swedish: Miljövårdsberedningen

building and real estate sector in 2025 (Miljövårdsberedningen, 2000 p. 6). This vision and strategy has been the basis for pointing out priority areas for the continued work and for formulating seven objectives (Table 2.13). Three areas of major concern have been detected: energy and resource efficiency, indoor climate, and the 'sound' use of materials. The 'ecological' part of sustainable development is in focus for the objectives proposed by the Building/ Living dialogue, even if they have tried to propose solutions that are also *'socially attractive and economically feasible'* (Miljövårdsberedningen, 2000 p. 7). The need for increased research and development is pointed out as one priority area. The dialogue group emphasizes the need for special knowledge centres to take charge of the development (Miljövårdsberedningen, 2000 p. 57). Among the many tasks for this knowledge centre should be to initiate and run demonstration projects and to disseminate experiences from these projects to the sector.

Local investments and demonstration projects

During the later part of the 1990s, the Swedish Government launched several programmes with economic support for environmental investments. *The 'Eco-Cycle Billion'*[23] had as its purpose to support the technical development mainly through the eco-cycle adaptation of buildings and infrastructure. Just as the following *Local Investment Programme*, LIP, the programme had the added advantage of creating employment in the building sector and elsewhere. Consequently these investments had the double function of being an instrument for ecological conversion and at the same time economic policy tools to address unemployment (Anshelm, 2002 p. 42; Baker, 2002 p. 110). This strategy to promote sustainable development and *'at the same as taking advantage of the opportunities that adjustment will offer Sweden'* (Swedish Government 1998/99:5) expresses the Swedish Government's strategy in line with 'ecological modernisation' (Anshelm, 2002; Baker, 2002). As such the LIP programme (1998 – 2002) was a broad programme for the ecological modernisation of investments to stimulate the modernisation of buildings, infrastructure and energy systems at a

1	No fossil fuels should be used for central heating or hot water after 2025. By the latest 2015, more than 50% of the energy needs should be met through renewable energy resources.
2	The use of purchased energy in the building sector should decrease by at least 30% by 2025 as compared to 2000.
3	By the latest 2005, sector relevant information will be available that makes it possible to reject building materials/constructions containing or giving rise to substances known to be hazardous to health and the environment.
4	By the latest 2010, all new buildings and 30% of the existing building stock are declared and classified with respect to building related health and environmental impact.
5	By the latest 2008, the use of substances and metals covered by the Government's guidelines for chemical use1 should be phased out within the building sector.
6	By the latest 2010, no more than 25% (counted in tonnes from 1994 levels) of the waste from new construction and refurbishment is used as landfill. By 2005 no more than 10% is used as landfill.
7	By latest 2005, the extraction of natural gravel should be limited to specific purposes and should not exceed 3 million tonnes per year in 2020.

Table 2.13 Seven objectives for sustainable development in the building sector proposed by the Building/Living dialogue (Miljövårdsberedningen, 2000 p. 28).

[22] In Swedish: Bygga/Bo dialogen
[23] The 'Eco-Cycle Billion' programme was never completed due to few applications and due to problems in the administration of the programme (Hanberger et al, 2002: 29).

local level (Swedish Government 1997/98:117 p. 8). Since 1997, Swedish municipalities have been able to apply for grants for local investments. A requirement to receive financial support has been the co-operation with different partners. Furthermore, a considerable part of the investments should be made locally. The Government has allocated 7.2 billion SEK (app. 0,7 billion Euros) for LIP until 2003. The initiatives that have been given support include investments for energy efficiency, conversion to renewable energy resources and building measures. For example, the demonstration project for sustainable building Bo01 in Malmö, Sweden received LIP support.

2.7 The Dutch agenda for sustainable building

The Netherlands has a similar background to Sweden regarding activities in the environmental area. The Netherlands and Sweden have had the ambition to play a role as environmental leaders within the European Union and the United Nations (Haneberger, 2002 p. 39).

The Netherlands set up political goals for the environmental adaptation of the built environment in the early 1990s. A first National Environmental Policy Plan was published in 1989 as a result of attention given to issues brought up by the Brundtland Report. A follow-up was published already in 1990, including an appendix regarding building activities (Hal, 2000; Hal et al., 2000). In 1995, the Ministry of Housing, Spatial Planning and the Environment introduced a National Plan of Action for sustainable building, in Dutch known as *Duurzaam Bouwen*, named *Sustainable building – Investing in the future* (VROM, 1995). This was followed up by a second National Plan of Action in 1997 (VROM, 1997). In the first action plan from 1995, the term 'sustainable building' is stated to mean (VROM, 1995 p. 3): *that consideration is given to environmental quality as a matter of course at every stage of the building process, i.e. from design to management'*. Sustainable building is described in terms of energy conservation, resource efficiency, adaptability to meet future needs, and the use of environmental friendly materials. Sustainable building should be seen as an 'extra quality'.

The main objective in the National Plans of Action for sustainable building has been to find ways to adopt environmental measures on a broad scale within the building process. This is brought about through

several steps, making all construction a little bit more sustainable rather than focusing on gaining a very high level of sustainability in just a few projects (Hal van, 2000:13) Within these National plans, financial support has been provided for a large number of activities implemented together with the private sector. Another governmental investment, aimed at integrating environmental measures to building regulations, was the introduction of the *Energy Performance Normative*, EPN with the Energy Performance Coefficient, EPC (the lower the better[24]), in the Dutch building regulations in 1995 (Figure 2.14). Furthermore, a new chapter on environmental issues was added to the Housing Act. A drawback for the development of sustainable building in the Netherlands is that no further tightening up of the EPC is planned at the moment, a fact that works against the initiatives from the building sector towards energy efficient goals (Sustainable Building: Frameworks for the Future, 2000).

Figure 2.14 The EPC value is successively decreased.

The Dutch government introduced a Policy Programme for Sustainable Building 2000 – 2004. Since this, no further investments have been planned for; instead the development should depend on voluntary actions from the market motivated by the advantages of sustainable building.

Instruments in the Dutch approach

An important instrument in the Dutch approach aimed at reaching an agreement upon a common definition of sustainable building was the introduction of the National Sustainable Building Package[25] in 1996, in continuation referred to as the National Package, (VROM, 1996). The National Package was prepared in co-operation with actors in the Dutch building sector. The National Package contains a set of voluntary measures for sustainable building. It is constantly updated and revised. The first package was addressed to new housing and was soon followed by packages for non-residential buildings, refurbishment, urban planning, and infrastructure. Among other things, measures for building design regard: energy, materials and water utilisation, design for

[24] EPC is defined by two components: the building technology factor with heat transmission through the structure, and by installationtechnology aspects. When introduced in 1995, the EPC demand in building regulations was 1.4, and was successively lowered to 1.0 in 2000.
[25] The first National Sustainable Building Package for housing has been translated into Swedish by the author, and this can be acquired from the author (Femenías, 1999b).

prolonged lifecycles and adaptability, and indoor climate. The ambition level in the National Packages will gradually be increased, while the lowest level of ambitions will be transferred to the building regulations[26]. The introduction of sustainability measures in the building regulations should insure that the actors are forced into sustainable building (Hal van, 2000). A report, *Monitoring Duurzaam Bouwen* from 1999, shows that 32% of all building permits from 1998 complied fully with the measures in the National Package (Hal van, 2000 p. 13). Another central point in the Dutch effort to harmonise knowledge was the establishment of the National Sustainable Building Centre in 1996 with the task of collecting and distributing knowledge and information for the entire building sector. The activities within the field of sustainable building have been a part of a larger governmental investment in environmental management and in fiscal instruments such as *groen beleggen*, green mortgages, low interest finance (linked to criteria in the National Package) through the *groenfonds* (green funds) (Baker, 2002).

Another important factor has been the national demonstration project programme for energy efficient and sustainable building assigned between 1996 and 1998. This national demonstration programme was initiated by the governmental organisations, the Steering Committee for Housing Experiments (Sustainable Building: Frameworks for the Future, 2000) and the Netherlands Agency for Energy and the Environment (Novem), and commissioned by the Ministry of Housing, Spatial Planning, the Environment (VROM) and the Ministry of Finance. The building projects, that have been selected and allotted finance within the demonstration programme, range from newly-built housing and office buildings to refurbished areas. The projects were chosen in a competition based on sustainable measures as stipulated by the first National Package from 1996. In all a total of 44 demonstration projects spread all over the country have been completed and evaluated[27] (Sustainable Building: Frameworks for the Future, 2000). Besides this demonstration project programme for energy efficient and sustainable building, other kinds of demonstration projects within the field of

[26] This refers to “measurements for which there is no possible debate” (measures applicable on a large scale). (Hal van, 2000)
[27] The results from this demonstration projects programme will be discussed in Chapter 2.

sustainable building and urban planning have been carried out[28] (for example, for energy efficiency - mainly for urban development and for municipal agendas).

The large national investments in sustainable building made in the Netherlands at the end of the 1990s have not been continued into the present century. Among other reasons, this is due to a change of the politicians in charge. According to actors in the Dutch building sector, there is little interest in sustainable building within the sector and among the general public at the beginning of the 21st Century (see Chapter 7). In order to involve the building sector and the public (who are clients for private housing), those who work with sustainable building issues today focus on other than environmental aspects when promoting sustainable building[29]. For example, health issues, indoor climate, quality, comfort, aesthetics, beauty etc. are set in focus. The national sustainable building periodical, *Duurzaam Bouwen* recently changed name to *Puur Bouwen*, which means 'pure building' or healthy building.

2.8 The state of sustainable building in Europe 2004

Since 1992, the European Union, EU, has engaged in action for sustainable development, even if this is not part of a coherent or deliberate strategy or policy thrust (Fudge and Rowe, 2000:42). According to Fudge and Rowe (2000, p. 42), the EU policy-making remains sectoral. The activities are divided over several of the Directorate General of the European Commission bodies (Sustainable Housing Policies in Europe, 2003 p. 37-42). The early focus on environmental protection has gradually been shifted to encompass social aspects of sustainable development. In 1990, a Green Paper on the Urban Environment was published, and in 1991 the EU Expert Group on the Urban Environment was established. The EU's Fifth Action programme on the Environment *Towards Sustainability* emerged in 1992 at the same time as the United Nations Earth Summit in Rio.

The European Union has defined sustainable housing to include three perspectives: the construction perspective, the social and economic

[28] See The National Sustainable Building Centre, www.dubo-centrum.nl (April 22nd 2004).
[29] Based on personal communication, June 7th 2004, with Anke van Hal PhD, environmental consultant and chief editor of the periodicals *Puur Bouwen* and *Puur Woonen*.

perspective and the eco-efficiency perspective[30]. The Working Group for Sustainable Construction Methods and Techniques (WGSC, 2004) was established by the EU Expert Group on the Urban Environment in order to give advice to the European Commission on sustainable building. In their final report on sustainable construction, the WGSC concludes that sustainable building has come a long way in Europe today, and has gained visibility not least through the success of numerous best practice examples. However, although we find relevant examples all over the EU, sustainable building is far from being a 'stream' and much less a 'mainstream'. The working group points out several factors that indicate the development of sustainable building at present. The WGSC states that there is a considerable amount of quality literature available on sustainable building. The relevance of sustainable development has been understood in the sector, and there is widespread popular support for sustainable building. Furthermore, there is a trend towards integrated solutions where the cultural heritage has been determined as an important factor in enhancing the quality of life.

The WGSC points out several barriers and constraints regarding sustainable building: economic constraints, availability of technologies, gaps in research, and major non-technical barriers. Among these non-technical barriers we find unclear political messages, culture and value related constraints, the difficulties in changing old methods and routines in the building sectors, market barriers etc. It will be necessary to study what different incentives and penalties are necessary to motivate each actor to become involved in the change towards sustainable building. The WGSC points out that until now the focus has been on housing, and less efforts and research have been made in the fields of refurbishment and non-residential building. Furthermore, the WGSC finds that there is a significant lack of widespread and practical design principles, and that existing tools lack clear definition and interpretation of sustainable building. There is an important gap between current knowledge and actual application, which must be addressed by dissemination. The WGSC emphasizes on the necessity to make information available, and to raise awareness through education and clear political messages. The

[30] Findings from the Third European Minister Conference on Sustainable Housing available at Website:
http:///www.mrw.wallonie.be/dgatlp/logement/logement_euro/Pages/Reunions/Genval/Colloque.htm

WGSC further emphasizes demonstration projects as an important means of disseminating concepts, ideas and solutions (see further Chapter 4). Interesting to note is that in the WGSC's objectives for sustainable building there are also less quantifiable quality-oriented objectives emphasized, such as identity and user's sense of belonging, and diversity of texture, colour and form. So far such quality objectives are unfortunately scarce in the discourse on sustainable building.

2.9 Summing up

The concept of sustainable development has its roots in earlier discourses of nature protection, environmentalism and the science of ecology, and has been integrated with the discourse of development in a global perspective. Adams (2001) in his extensive exploration of the concept has found that it has been codified and developed through the last three decades in several documents, where the Brundtland report *Our Common Future* from 1987 and the *Agenda 21* from 1992 have had main impact. The concept of sustainable development has been widely spread and known through two key events: the United Nations conference in Stockholm in 1972 and the United Nations conference on the Environment and Development in Rio, or Earth Summit, in 1992.

Although there are counter currents within the discourse of sustainable development, the concept is characterised by a mainstream of ideas. This mainstream is based on the power of government, science, technology, and the rational management of resources to maximise human welfare. This mainstream sustainable development is not mainly founded on ecological based concepts but on a socio-economic context. Its success in engaging governments all over the world can be explained by it being built on existing economic systems of growth, and that it does not imply radical changes of governing procedures. Sustainable development is usually perceived as consisting of a social, economic and environmental dimension.

Ecological modernisation, market environmentalism and environmental populism are important thoughts within mainstream sustainable development. Together they build up a mainstream sustainable development based on capitalist growth, a techno-centric view of solving environmental problems, and public participation with

the purpose of legitimising governmental action. Several authors distinguish what can be called weak from strong ecological modernisation. The weak ecological modernisation is then characterised by a defensive, economist, instrumental, unitary, and technological/technocratic view. The strong ecological modernisation is characterised by an offensive, ecological, communicative, diversifying, and broad and democratic/grass-roots' view.

Both Sweden and the Netherlands have approached ecological modernisation in their national policy work for sustainable development. The Swedish government's work since 1996 is based on the idea of sustainable development. Among other results from these endeavours are a national strategy for sustainable development, the 15 national environmental quality objectives for the environment, and an environmental code. Both in Sweden, and within the European Union, a shift has been observed from an early focus on environmental issues towards an acknowledgement of social and cultural aspects as being important for sustainable development.

Sustainable building

The building sector and the built environment contribute considerably to the degradation of the natural environment and are regarded as two areas of major concern for sustainable development, both nationally in Europe and globally. There does not exist any single internationally accepted definition of the concept of sustainable building. Such a definition is not even realistic due to local conditions and constraints, specific contexts, as well as national and cultural preferences and priorities.

Sustainable building, on the one hand, concerns determining the complex relations between building activities and the built environment, and the natural environment as well as determining the influence on the social, human, cultural spheres etc. Firstly, it must be determined *what* sustainable building is. On the other hand, an agenda has to set the guidelines for *how* to accomplish sustainable building. The implementation of sustainable building is constrained by the complexity and fragmentation of the building process involving many actors from different cultures and differing interests (see, Chapter 3). In general a life-cycle approach and a systemic approach are proposed for the planning, design and maintenance of buildings aiming for prolonged

lifetime and flexibility of design. Other important factors are the collaboration between actors in the building sector in order to accomplish their tasks, as well as an Integrated Design Process. The Integrated Design Process focuses on co-operation on a project level as well as the important involvement of a 'process champion', or 'process master', with the task of safeguarding the ambition to produce a sustainable building throughout the project.

The national agendas for sustainable building in Sweden and the Netherlands must be seen as emerging from their respective national strategies for ecological modernisation and mainstream sustainable development. In Sweden, the government has set up objectives and consensus has been reached between different partners in the building sector as to the objectives and agendas for sustainable building. The main areas of concern are energy efficiency, a limitation or stop for the use of fossil energy resources, rejection of hazardous substances in building materials, limitation of natural resources (gravel, metals etc.), and the reduction of building waste (also reuse and recycling). The built environment should provide a healthy indoor climate, be socially attractive and economically feasible. The agenda for sustainable building further involves the spreading of information and to support education in these issues within the sector. Furthermore, it involves changed standards, as well as changes in organisation and administration in the sector.

In the Netherlands, political directives for sustainable building were set up in the early 1990s as part of the National Environmental Policy Plans. The involvement increased through two National Actions Plans for sustainable building published in 1995 and 1997. Since the beginning of this century the issue is receiving less political attention. The National Action Plans provided several instruments for the implementation of sustainable building in the Netherlands: definitions, information, subsidies, green mortgages, demonstration projects, etc. One of the major instruments was the National Sustainable Building Package, prepared in co-operation with the Dutch building sector, with definitions and measures for sustainable building that are constantly revised and up-dated as measures are diffused to mainstream building. Another important instrument has been to carry out and evaluate a large number

of widely spread demonstration projects for energy efficient and sustainable building.

The European Working Group for Sustainable Construction Methods and Technique, the WGSC, has in a final report on sustainable building concluded that sustainable building has come a long way in Europe. Sustainable building has gained visibility not least through numerous best practice examples. However, sustainable building is far from being a ‘stream’, and much less a ‘mainstream’. Barriers and hindrances are found among available technologies, economic constraints, gaps in research etc. There are also major non-technical barriers such as unclear political messages, culture and value related constraints, the difficulties in changing old methods and routines in the building sector, market barriers etc. The WGSC states that it will be necessary to address incentives and penalties to motivate the actors in the building sector. There is an important gap between existing knowledge and the actual application. The WGSC places emphasis on information, education, clear political messages and the implementation of demonstration projects.

Chapter 3 The Building Sector: Conditions for Development, Learning and Innovation

This chapter provides a theoretical basis for the thesis in discussing conditions for development, learning and innovation in the building sector. The chapter presents theory within the fields of design, innovation, organisation and management. Firstly, a general description of the building sector is provided: its actors, the structure, and the organisation of work. The description is mainly based on the Swedish context but the conditions for knowledge build-up and development should generally be similar in other national contexts (see for example Hal van, 2000). Secondly, a presentation is given of the conditions for knowledge build-up in the building sector, the professional know-how and the role of the example. Thirdly, an introduction is provided about organisational learning and fourthly about the innovation-diffusion process. Lastly, an outline is presented of the factors that will influence development, learning and innovation as well as in other areas for sustainable development within the building sector. Altogether, this chapter provides a background for understanding the initiating and receiving context regarding demonstration projects for sustainable building.

In several countries around the world, including Sweden attention is currently being given to the need for improving the mainstream building process. These commitments are based on similar structural problems and lack of incentives for innovation and development in the building sectors (Swedish Government, 2002:115; Building for growth, 1999; Constructing for excellence, 2001[31]; Rethinking Construction, 2002).

[31] Building for Growth (1999) *An analysis of the Australian Building and Construction Industries*, Industry Science Resources, Commonwealth of Australia; and Construct for Excellence (2001) *Report of the Construction Industry Review Committee*, January, SAR, Hong Kong. Both Quoted in Dulaimi et al. (2002)

3.1 The building sector

Included in the *building sector* are all institutions, organisations and actors that contribute to the production and management of buildings (or civil engineering works). This includes the *building industry* that is directly involved in the production, renewal, repair and maintenance of buildings and civil engineering works. Thereby the management of buildings is not included in the building industry. Furthermore, the building sector includes the designers, the financing companies, the insurance companies, the producers and sellers of materials as well as the real estate agents (Swedish Government, 2002:115; Lutz and Gabrielsson, 2002).

The building sector in Sweden is the second largest sector in society after the health care sector and is of considerate importance for the national economy (Swedish Government, 2002:115). Altogether the building sector is the European Union's largest industrial sector, contributing approximately 11% to the GNP, and having more than 25 million people directly and indirectly involved (CIB, 1999).

The structure of the building sector

The building sector is in general largely national or even local, diversified and fragmented (CIB, 1999). The majority of the construction companies in Europe are small or medium-sized operating with few employees.

In Sweden, structural changes provoked among other factors by the economic recession of the 1990s, have resulted in a few larger national actors dominating the market among building contractors (Swedish Government 2002:115 p. 86). A similar development towards a few larger, and a range of very small actors, has for instance affected the consultancy firms, the building material industry, and installation engineering firms. The stronger contractors have nowadays taken on the function of clients and developers for their own production. At the same time the traditional clients have lost competence and power for among other reasons: the detailed regulation of buildings during the 1960s and 1970s, and the low volume of housing construction during the 1990s. At the same time many government-owned and municipal clients have disappeared. As a result a change in the power balance can be observed

with a weakened position for the traditional clients to the favour of a stronger building contractor (ibid).

The main actors

The *client* is a key actor in the building process with the responsibility for the production and the product as well as the investments and financing. The client also has the *legal* responsibilities that the design and construction is carried out according to the legislation and regulations (Swedish Government, 2002:115 p 67). Even if the client, for example, commissions a contractor, the client has the ultimate responsibility.

The *users*, for example the tenants, are the actors that have the least influence on the building process, even though being those most affected by the results (Swedish Government, 2002:115 p. 68). The client is the one who indirectly is supposed to satisfy the users' interest in the building process by identifying the presumed need and wishes of the users.

The *architects* and other *consultants*, such as constructional engineers, contract managers, contract co-ordinators etc., in practice contribute with the main part of the competence and knowledge that the client and the constructor need to carry out their tasks. This presumes that the main resources should be invested in the initial parts of the building process. In reality less time is set out for the design, in relationship to the total size and budget of the project, and architects and other consultants are not given sufficient resources to use their competence (Swedish Government, 2002:115 p. 70). For example, the larger architects' offices in Sweden currently use only 50% of the time on a project in comparison with the 1970s (Swedish Government, 2002:115 p. 70).

The *contractor* constructs, changes, repairs and maintains buildings and engineering works according to the commission of the client. Most works are carried out on a design and construct basis (termed turn-key contracting) or general contracting[32] (Swedish Government, 2002:115 p 70). In a design and construct contract the contractor is responsible for the commission and the co-ordination of designers and other consultants.

[32] In Swedish: totalentreprenad or generalentreprenad.

Usually the lowest tender is the ultimate criteria for the commission. A large part of the construction work as well as specialised tasks, such as electrical installations, ventilation, and plumbing, are carried out today by sub-contractors commissioned by the contractor. At present, many contractors also take the role of clients for their own production.

The *government* has several roles in the building process (Swedish Government, 2002:115 p. 71). It has the ultimate responsibility for deciding housing policy legislation, building regulations and laws affecting the building sector etc. The government is also a large actor on the real-estate market through governmental authorities and government-owned real-estate companies. The housing production in Sweden during the period from the 1930s until the mid 1990s was to a large extent directed through political strategies, subventions and loans (see for example Ericson and Johansson, 1994). Since the mid 1990s, the political directions in the housing sector together with subventions and loans have diminished drastically (see for example, Turner and Vedung, 1997).

The *local authorities* also have several important roles in the building process through which they can influence building activities and their costs. The local authorities can act as: landowners, holders of the planning monopoly, as actors on the building and housing markets or as a permission-granting or supervisory authority, for example, in building or environmentally related questions (Swedish Government, 2002:115 p 73).

The role of the *finance companies* is to evaluate the projects concerning risk, yield and profitability (Swedish Government, 2002:115 p. 78). Since the building crises of the 1990s, the demand for high and quick yields on invested capital has forced the production speed and set the focus on the granting of venture capital to projects considered to give quick and secure yields (ibid). As a consequence, the long-term advantages from investments in techniques and materials that will provide low costs in the management and administration spheres are underestimated.

3.2 The organisation of work in the building sector

The major difference between the building sector and other industry is that the building process is *fragmented* with many actors that possess specialist knowledge. The building process can be characterized as being similar to a relay race where the different actors succeed each other (see for example Kadefors, 1997). This fragmentation and specialisation, according to Ericson and Johansson (1994 p. 21), is a consequence of the specialization in society in general, and especially in the technological sphere, with roots in the 'Taylorism' and the logic of the capitalist market economy.

The temporary project organisation

The building sector is mainly organised in what might be called *temporary organisations*. The building project can be characterised as a temporary organisation[33]. Lundin and Söderholm (1994) have developed a 'theory' of temporary organisations using four concepts: *time, task, team and transition*. Firstly, the temporary organisation can be characterized by being limited in time. Secondly, the temporary organisation is motivated by a special task. Thirdly, the temporary organisation is designed by and around a *team* of actors formed for the task. These actors normally belong to a 'home' organisation before, during and after being involved in the temporary organisation. From this team organisation emerges two concepts. Firstly, the relationship between the individual and the team, and secondly, that between the team and the team environment in which it is working[34]. The expectations and experiences of each individual in the team can merge or not merge with those in the team. It is not possible for one single profession to codify the whole team. Lundin and Söderholm (1994 p. 442) argue that the very fact that the organisation is temporary may be a condition for the acceptance of conflicting interests in the team.

[33] One of the most well known definitions is stated by the non-profit organisation 'The Project Management Institute' (PMI): "[A] project is a temporary endeavour undertaken to create a unique product or service" (Engwall, 1998 s. 25).

[34] The temporary organisations' or the building projects' environments can be: the physical environment, the economic environment, the political environment, the juridical environment, the cultural environment and other environments, such as professional groups, sector organisations private persons etc. (Josephson, 1994 p. 64)

Individuals will also enter and exit the team at different times so the 'rules of the game' may change (ibid). Lundin and Söderholm argue that the relationship between the team and the team context/environment mainly focuses on the legitimisation of the team and the task it should accomplish. The team has to relate to the context, which may include competing organisations, or organisations that are simply uninterested in the temporary organisation. Team members may even be 'isolated' inside the temporary organisation and create their own norms.

Lundin and Midler (1998 p. 233) use the words 'arena', and the metaphor with a bullfighting arena, to characterize a project in order to mark that there is a social frontier between those 'inside' the project and those 'outside'. Being inside or outside that frontier provides different roles for the actors. Those inside have the role to act or perform, whereas those outside are safe to look on and judge. The frontier of the arena can create a radical change in behaviour. For the participant it creates a focus and for the spectators visibility and control. The arena is thus a social construct by which a singular problem is extracted from a 'messy' context.

The fourth basic concept for understanding temporary organisations described by Lundin and Söderholm (1994 p. 442), the *transition*, is justified by the concern with progress and accomplishment. This orientation towards action is the very reason for having a temporary organisation; to fulfil the task, in our case the building project. The transition can be described as a change from 'before' to 'after' and also involve changes in instrumental behaviour, changes in meaning, culture and ideology. Lundin and Midler (1998 p. 232) point out that a project at the same time has an *action* perspective and a *learning* perspective, even though it is primarily a goal-orientated problem-solving process. Usually there is dialectic in the relationship between the two perspectives implying that one perspective will be neglected as the focus is on the other. The existence of a hard and clear arena frontier in a temporary organisation would be counter-productive to the learning imperative. The clear frontier is motivated as it has a focusing effect in the implementation phase of the project and minimizes disturbance through isolating the organisation from the context (Lundin and Söderholm, 1994 p. 447).

3.3 Knowledge build-up in the building sector

Knowledge in the building sector is mainly developed through practice; through the building of projects (see for example Linn, 1998). Information is searched for when needed and solutions to problems are normally sought for as they emerge within the specific project (Ericson and Johansson, 1994; Wallin, 2002; Josephson et al., 2003). This empirical-practical knowledge building process is not systematic or controlled by scientific methods but based on personal experiences. It is often characterized as being subjective and contextual (Ericson and Johansson, 1994; Linn, 1998). Contemporary fragmentation and specialisation of activities in the building sector have lead to an increased need for controlling competence and knowledge using different models and systems for the control of activities as well as the quality assessment of results (Ericson and Johansson, 1994 p. 20). However, on an everyday building project level the knowledge processes are driven mainly by decisions taken on the spot and in relation to a specific situation (see also Larsson, 1992).

Several authors indicate that the process of knowledge build-up in the building sector, as well as changes in the building practices, is slow and takes place in small steps (Rudberg and Winqvist, 1990; Larsson, 1992; Ericsson and Johansson, 1994). The practical-empirical method for knowledge build-up in the building sector is based on a chain of planning, design, construction, evaluation, feedback and reflection. There will be several years between the planning of a project and the feedback of results.

Learning in general is closely related to previous activities and experience (see for example Molander, 1993). In the building sector several factors challenge the efficiency of learning and knowledge build-up processes (Dubois and Gadde, 2002; Josephson et al., 2003). Firstly, the project organisation does not promote learning. One reason for this is the temporary nature of the building project that does not guarantee any further contact among team members. The temporary building project is problematic as it has no long-term organisational memory. Building projects can be seen as a *host for knowledge* (Bröchner et al., 1991; Lundin and Söderholm, 1998). The ideal is that the individual actor that participates in the temporary project will bring his/hers experiences back to the ‘home’ organisation and into new temporary project organisations.

However, often little effort is devoted to transmitting knowledge and experience from one building project to another (Dubois and Gadde, 2002; Josephson et al., 2003). An obstacle to learning is that each building project is considered as a *unique* event (Ericson and Johansson, 1994; Dubois and Gadde, 2002; Lutz and Gabrielsson, 2002). Next time there will be new circumstances, new prerequisites and new actors. This is also related to the fact that there are seldom long-term relationships between actors in the building sector.

A second explanation is found in the fragmentation of the building process involving many actors from different professional groups sometimes resulting in difficulties in mutual understanding and communication. Moreover, the fragmented building process is divided in clearly defined phases and knowledge is often lost in the transition from one phase to another as actors enter and exit the project (Linn, 1998; Josephson et al., 2003). Some key actors enter late in the process and consequently do not have the same knowledge base for their participation in the project (Josephson et al., 2003).

A third factor is the decentralised decision-making process and ad-hoc problem-solving at the spot does not encourage systematic long-term thinking with regard to knowledge build-up (Dubois and Gadde, 2002; Josephson et al., 2003). The work situation for the individual is also characterised by stress due to the limits of expenditure in the building project leaving little time for reflection over the work before a new projects starts. The building project organisation is further characterized by uncertainties and indistinctiveness (Sahlin-Andersson, 1986, 1989; Josephson, 1994). This refers to the characteristics of the final product as well as the building process. The uncertainties are reduced as the project proceeds. The indistinctiveness in future conditions can provoke irrational acting, which in turn works against flexibility and efficiency (Josephson, 1994).

A fourth factor can be found in the individuals' interest in and attitude to learning (Josephson et al., 2003). The individual actor in the building sector is part of a profession and an organisation that will have an influence on the individual. In the following sections, professional knowledge and learning as well as organisational learning will be discussed.

3.4 Professional knowledge and the role of the example

Linn (1998 p. 28) identifies three kinds of sources for knowledge concerning building practices: the products (buildings, landscapes etc.), written documents (documents from the process etc.), and the living *praxis* (with tools, methods, values, problem views etc.). The first two of these sources are concrete and explicit in that sense that they can be made available and accessible for an observer. The third source, the praxis involves implicit and *tacit* knowledge that in some cases can be difficult to make explicit and understood for an observer.

Lundequist (1984 p. 31) describes the concept of praxis as an abstraction that is made up by the common ideas and patterns of actions carried out by an identified group of people. Praxis is constituted by the rules and the institutions, with surrounding forms of praxis that altogether make up the specific context for the praxis. Winch (1958/1988 cited in Lundequist, 1995b p. 45) has concluded that if people act in the same manner in different situations they follow a rule. These rules are difficult to make explicit and to explain in words, as they have to be understood in their context. To be a part of praxis means that one has learnt to handle the rules and concepts used in the praxis. This means that one has learnt to conceptualise a certain part of reality. According to Winch (1958 cited in Lundequist, 1995b p. 50) research can articulate praxis through making the essential concepts for the praxis explicit.

Professional knowledge can be defined as the ability to function and act in a professional praxis (for an extensive introduction to professional knowledge, see Schön, 1984, Molander, 1993 and Rolf et al., 1993, Lundequist, 1984, 1995b). All members of the group that constitute the praxis are collective bearers of this praxis. Some of the rules in praxis are explicit while others are implicit: they are transmitted from a mentor to an adept, through *learning-in-action* (Schön, 1984; Molander, 1993). As stated by Schön (1984 p. 49), professional knowledge is characterized by being familiar with a phenomenon. Professional knowledge is characterized by a method to approach a problem-solution for which the professional cannot explicitly state the rules or the procedures. Such tacit knowledge or ‘know-how’ (see Rolf et al., 1993) is according to Polanyi (1964, 1966 quoted in Lundequist, 1995b, p. 62)

both bodily knowledge that is accumulated and taught, and contextual knowledge that is supported by cultural traditions. A professional praxis functions as a supporter for tacit knowledge. Tacit knowledge is acquired when a person learns to function in praxis (Lundequist, 1995b p. 62 drawing on Rolf, 1991 and Polanyi, 1964, 1966).

A complementary dimension to the tacit part of professional knowledge is the *reflection* or *reflection-in-action* (Schön, 1984; Molander, 1993; Rolf et al., 1993). The reflection is the basis for development of the professional knowledge. While acquisition of professional knowledge or know-how belongs to single-loop learning, reflection upon the normal procedures is a necessary element to trigger double loop-learning i.e. changes in collective procedures and know-how (Rolf et al., 1993 p. 34; Argyris and Schön, 1996).

Furthermore, Rolf (1991 quoted in Ericson and Johansson, 1994) introduces the expression *intimate knowledge* to characterise a dimension of professional knowledge. Intimate knowledge can have a conservative effect on a profession. A profession can be so intimate with an activity that the *real* conditions will remain hidden. The confidence can, if based on more or less false ideas, be a hindrance for competence and knowledge development, a 'confidence trap'. Ericson and Johansson (1994) discuss that emphasise on tacit and intimate knowledge concerning professions in the building sector does not mean that this knowledge should be left outside a critical discussion.

Transfer of information and experience

When referring to acquisition and transfer of professional knowledge a distinction has to be made between *information* and *knowledge* (Molander, 1993; Lundequist, 1995a). Information can be objectified and stored, communicated or elaborated, like for example in written documents, drawings, videos etc. Knowledge on the contrary is something that only a person can have. Information is a product of a sender's knowledge, but it is not knowledge. In order to become knowledge, the information has to be interpreted by a person (Lundequist, 1995a). The information itself does not carry the interpretation, but has to be presented in such a way that the message is communicated (Lundequist, 1995b p. 10). Moreover, Molander (1993) distinguishes between orientation-knowledge and knowledge-in-

disposition. The orientation knowledge is based on understanding, identity and pre-understanding and gives us the means to make decisions based on a trained ability to see what is important and correct. The knowledge-in-disposition refers to the instrumental knowledge, general rules, and knowledge that give us the tools to be in command, for example, of a technical procedure.

A model involving four factors is normally used when explaining the process of transfer of information/knowledge: the sender, the receiver, the information/knowledge, and the ability to express the knowledge in text (Rolf et al., 1993 p. 19). Rolf et al. (1993) point out two problems in this model for the transmission of knowledge. One the one hand, there may be problems in the communication. For example, if the receiver has insufficient pre-knowledge in the field to be able to interpret the information communicated. The interpretation has to be made against a background of a context. It can also be a case that the sender has not been able to adapt the information to the situation of the receiver. On the other hand, problems can occur in the articulation of the knowledge in text. For example, this concerns procedures that cannot entirely be reproduced solely through a description, and for example what concerns tacit knowledge. Molander (1993) argues that all kinds of knowledge have a tacit side. No kinds of knowledge are entirely tacit and all kinds of knowledge are basically tacit. Janik (1991 quoted in Lundequist, 1995b p. 63) distinguishes two kinds of tacit knowledge: one that can be externalised but has not been given expression via language, and one that is not possible to articulate entirely. This latter kind of tacit knowledge concerns knowledge that involves the use of rules that are frequently taught through identified good examples.

The role of the example

The example has an important role in the transmission of professional knowledge. The practitioner builds up a personal repertoire of precedent familiar examples, images, understandings, and actions to be used in new unfamiliar situations (Schön, 1984 p.138). Such a repertoire of ‘good examples’ is usually shared and developed by individuals in a profession or praxis.

In general, examples have the role of making the abstract comprehensible. According to Ramirez (1995, 1997), the general can

only exist in our imagination. Solely the concrete example exists in the world (Ramirez, 1995 p. 2):

> Concretisations and examples verify the generally valid and make it visible and communicative.

Once the comparison or metaphor is understood the example can be forgotten (Ramirez, 2001). The example has been reduced to its essential. The exemplification results in a general experience to be used in similar situations. The example becomes a bridge between the specific and the general. In such a process the good as well as the bad example fills a function (Ramirez, 1997 p. 257). The example should not be followed mimetically. It is not a rule that can be followed literally. According to Ramirez, the example talks to the reason and not the instrumental action (ibid).

The example also has the advantage of illustrating comprehensive views on a subject (Molander, 1993; Lundequist, 1995b). Complex artefacts as in the case of buildings must be studied and understood as non-reducible entities (Linn, 1998). The function of the parts and components cannot be defined unambiguously as the building is not only a physical object but also the basis for certain life situations, cultures, social relationships etc. The concrete example will facilitate the understanding of the complexity of the building. The comprehensive understanding of an example is not only based on our personal understanding but also influenced through the communication with others, for example, in a profession (Lundequist, 1995b).

Of special relevance for this thesis is the transfer of experiences from a built example to be used in new decision-making situations. As argued by several authors, the transfer of experiences from a built example must include the contextual circumstances in which the building was produced (Sahlin-Andersson, 1989; Birgersson, 1996; Karlöf, 1997). A building project involves many contextual and unique conditions. In order to make the example useful, that which is generally applicable has to be distinguished from that which is specific. The example can be found to be product related or process related. For instance, it may be a technical innovation with general applicability, but it may also be the implementation of a technical innovation through a process with special conditions (project organisation, co-operation, subventions etc.) that

cannot unduly be reproduced in a new context (see further Birgersson, 1996). Birgersson et al. (2001) have discussed this problem using the conceptual pair of space – place. Space relates to the general non-contextual laws applicable on a large scale while place is the specific and situation bound.

3.5 The learning organisation

The building sector includes both the temporary building project organisations and the more stabile 'home' organisations for the actors in the sector. In the following conditions for learning regarding the stabile organisations will be presented from the point of departure of theory on organisations and organisational learning.

An important criterion for measuring the success of the stabile organisation is the survival, and in order to survive the organisation has to develop (Holmblad Brunsson, 2002). This continuous development can be seen as a learning process. Furthermore, the organisation has to interact in some way with its environment and to care for its legitimacy. It has to fulfil certain expectations from its environment (ibid). Consequently, in order to learn the organisation has to respond to its environment. Through its actions the organisation will in turn have an influence on its environment. Accordingly, organisational learning can be characterised as an iterative process where the organisation 'maps' the environment and uses these maps to change the same (Josephson, 1994 drawing on Hedberg, 1984). As the information about the environment is often incomplete and difficult to access or to use, the organisation has good reason for being slow in development. Consequently, it may be safest to continue in the old routines (Holmblad Brunsson, 2002 p. 22-26). Argyris and Schön (1996) call this phenomenon the 'competence trap'. The organisation persists in familiar patterns beyond within which it yields successful outcomes.

It can be argued that organisations often develop through observation and imitation of other organisations (DiMaggio and Powell, 1983). In this way the organisation can either legitimate its own behaviour, or find other models to imitate or to reject. In insecure situations, when objectives are ambiguous or uncertain, organisations have a tendency to

imitate and model themselves upon other organisations they for example find to be more legitimate or successful (ibid).[35]

Models for organisational learning

On the one hand, individual learning is a necessary condition for organisational learning (Argyris and Schön, 1996 p. 6-7). On the other hand, in many cases knowledge held by the individual fails to enter the organisation and consequently the organisation knows less than its members. Conversely, there are also cases when the organisation seems to know more than its members, for example, in an army (ibid). From this point of view, organisational learning can be seen in terms of 'organisational environment' or 'arenas' within which the individuals think and act (Hedberg, 1984 quoted in Josephson, 1994; Argyris and Schön, 1996).

As already discussed, individual learning can be described as an iterative trial-and-error process involving action and a reflection over this action (see, Kolb, 1974 quoted in Josephsson, 1994; Schön, 1983; Molander, 1993). The individual learning will also be influenced by the context and by personal and professional representations and concepts (see section 3.3). For the small organisation with a few individuals, organisational and individual learning are similar. The large organisation, however, needs some kind of system to disseminate the individual knowledge to the organisation as a whole.

Bröchner et al. (1991 p. 100) highlight two ways for actors in the building sector to build-up knowledge. Either the organisations generate their own experiences or they use experiences generated by others, which are transmitted through media, literature, lectures etc. The organisational researchers Dibella and Nevis (1998 p. 86) distinguish between incremental and transformative, internal and external

[35] Besides this mimetic isomorphism, DiMaggio and Powell recognize coercive and normative isomorphism. Coercive isomorphism is the results from formal and informal pressure exerted on an organisation from other organisations upon which they are dependent or by cultural expectations in society. Such pressures can be felt like a force but also as invitations. This can also be governmental mandate, for example, to conform to sustainable development. The normative isomorphism is associated with professionalism. The collective profession has as occupation to define the conditions and methods to

organisational learning (see further section 3.6). While the internal incremental learning refers to a basic correction of existing procedures and products, the internal transformative learning refers to innovation. The external incremental learning is called adaptation. This means that the organisations take basic ideas from external sources, knowledge developed elsewhere, and use these to improve their own procedures. The external transformative learning demands some amount of acquisition, usually that the organisations purchase capabilities developed by others.

Dibella and Nevis (1998, p.89 – 92) further distinguish four possible styles of learning capacity within an organisation: The first, role modelling handles the intuitive silent skills or implicit knowledge that is disseminated in an informal manner through person-to-person relations. The second, communities of practice, involves collective learning in an informal manner. Individual experiences are shared, and in this process new learning takes place by collectively generated insights that the individual could not have produced alone. The third, the mode of the authorized expert, uses formal ways of dissemination through an expert that functions as an adviser within the organisation. Finally the fourth, bureaucratic mode disseminates experiences mainly through written sources.

Bröchner et al. (1991) found in Sweden that the formal systems for knowledge transmission within organisations in the building sector were fairly good among building contractors, but less developed among the consultancy firms. Among the consultants (architects, engineers) informal methods, such as person-to-person contact, were the most common ways of dissemination. In the architectural firms, knowledge dissemination within the organisation often works through mentorship between the experienced and the less experienced. Furthermore, architects often go on study trips and read national and international trade press (Bröchner et al., 1991 p.103). The authors in their study find it remarkable that the organisations in the building sector do not find the build-up of knowledge to be of specific interest for their future.

As already discussed in Section 3.4, Argyris and Schön (1996 p. 20 – 25) distinguish between two kinds of organisational learning processes:

establish a base and legitimate the members. This is exceeded, for example, through professional networks, education etc.

the single-loop learning and the double-loop learning. By single-loop learning is meant instrumental learning that changes strategies of action in ways that do not consider the values of the theory of action or *theory-in-use*. That is to say that the dominating values and representations on which the organisation has built up its activities are unchanged. The single-loop learning can be characterised as an incremental process where the organisation adjusts action strategies or assumptions within the range set by existing organisational values and norms. Single-loop learning is 'instrumental incremental' and concerned primarily with effectiveness. More difficult to achieve is the double-loop learning, which implies change in theory-in-use. According to Lundin and Midler (1998 p. 239), double-loop learning is connected with innovation and radical change. The theory-in-use, according to Argyris and Schön, can be embedded in norms, strategies, assumptions, etc. The theory-in-use may be tacit rather than explicit, and may even be in opposition to the organisation's formal documents, such as policy documents and job descriptions. Since theories-in-use are supported by organisational and social cultures, individuals have little reason to be aware or to explore these further.

Hindrances for organisational learning

Through their empirical work, Argyris and Schön (1996 p. 76) have found that the theories-in-use in the studied organisations were systematically counter-productive for double-loop learning especially when the issues are embarrassing or threatening. The organisation reacts defensively and thus responds to the environment that is focused on success through suppressing the errors. The organisation falls back to single-loop learning.

Holmblad Brunsson (2002 p. 183) mentions other hindrances for organisational learning. She argues that through the choice of information systems and procedures the organisation can disregard its own experiences. The information systems are selective and large parts of reality may be forgotten. In structural changes and in the adoption of new procedures it is advantageous for the organisation if its members forget quickly. Bröchner et al. (1991) point out the necessity of liquidating old knowledge in an organisation in order to prepare for renewal. The liquidating of old knowledge, however, can meet

opposition as those individuals with special knowledge within an organisation usually have an influential position that they are not prepared to loose. Moreover, organisations with many new members or new directors forget more easily (ibid).

Other hindrances for learning are found in organisations that are either highly specialised or have the strategy of simplifying their work. When simplifying, the organisation focuses on one task and disregards others (Holmblad Brunsson, 2002).

3.6 Innovation and adoption

The innovation and adoption processes represent two ways for the organisation to learn and thus develop. On the one hand, the organisation can invest in innovations (internal transformative learning according to Dibella and Nevis, 1998), and on the other hand, the organisation can adopt innovations made by others (external incremental learning according to Dibella and Nevis, 1998).

The term innovation means 'the introduction of something new' or 'a new idea, method, or device' (Merriam and Webster's Collegiate Dictionary online, www.m-w.com, March 2004). Rogers, the founder of a well-known model for innovation-diffusion processes, defines innovation as (Rogers, 1995, quoted in Hal van, 2000 p. 16):

> An innovation is an idea, practice, or object that is perceived as new by an individual or another unit of adoption.

Dosi (1992 drawing on Freeman, 1974) emphasizes the distinction between *invention* and *innovation,* where the former is potentially marketable and the later marketed. Accordingly, an innovation is first accomplished with the first commercial transaction.

An innovation can be attributed five characteristics through which it becomes interesting for potential adopters (Rogers, 1962 p. 124 – 134): 1) the relative advantage, 2) the compatibility (to existing values and experiences), 3) the complexity (the degree to which it is difficult to understand and use), 4) the divisibility (the degree to which it can be tried on a limited basis), and 5) the communicability (the degree to which the results may be diffused to others). Other factors that will influence the potential adopter are (Rosegger, 1981 quoted in Larsson,

1992 p. 28): the technical characters of existing systems in the organisation; profitability and economic conditions, technical competence in the organisation; market position and alternative strategies; and the attitude of the direction of the organisation.

A few individuals or groups of individuals within an organisation take the decision to use or reject and innovation. In general larger firms have better finances to innovate and adopt as this involves risk. Some factors however work against this; as for example large firms are more bureaucratic and consequently reluctant to innovation (for an introduction to innovation and adoption theory in construction see Larsson, 1992).

Diffusion of innovations and adoption

There are four crucial elements in the analysis of the diffusion of innovations: 1) the innovation, 2) its communication from one organisation/individual to another, 3) in a social system, 4) over time (Rogers, 1962 p. 12). Rogers distinguishes between the *diffusion processes*, which is the spread of a new idea from its source of invention or creation to its users and adopters, and the *adoption process*, which is the mental process through which the potential adopter passes from introduction to adoption. Rogers presents the adoption process as consisting of five stages: awareness, interest, evaluation, trial and adoption. He further discusses different categories of adopters from the innovators to 'laggards'. The innovators are the venturesome eager to try new ideas. The early adopters are more integrated in the social systems and more locally bound than the cosmopolitan innovators. Rogers indicates several kinds of adopters from early adopters down to the 'laggards' who are traditionalists and the last to adopt. The early adopters have the shortest time period between awareness to trial while the late adopters and the 'laggards' have longer time periods before adopting.

Rogers and Shoemaker (1971 quoted in Larsson, 1992 p. 26 – 27) highlight three factors that determine the ability to adopt: the socio-economic status, personal variables and communication. Within the first they find that organisations with individuals with higher education are more likely to adopt. The personal variables are more difficult to determine, but Rogers and Shoemaker make some generalisations and

state that individuals that adopt are less dogmatic, more rational, intelligent and venturous. Individuals that adopt are more integrated in social systems, they are cosmopolites and they search for first-hand information.

Rogers (1962) recognizes the importance of *opinion leaders* and *personal communication* in the adoption process. The personal, face-to-face communication is even more important for the late adopters. The innovators and early adopters are more likely to rely on first-hand sources. However, the personal communication is most influential in the later stages of the adoption process when approaching an adoption or rejection of the innovation. Awareness of an innovation is mainly caused by impersonal communications such as media. Interesting to note is that Rogers (1962 p. 225) finds that we are often less selective in our exposure to personal influence than in exposure to mass media.

Finally, Rogers (1962) points out the importance of *change agents* or *change agencies* that serve as a communication link between a professional system and the clients system. A change agent, according to Rogers, is a professional person and there can be many kinds of change agents. Change agents can be commercial change agents, such as salesmen or local-level bureaucrats. According to Rogers, the change agents should concentrate their efforts upon opinion leaders in the early stages of the diffusion of an innovation.

Hughes (1987 in Kain, 2000 p. 71) points out the importance of understanding the characteristics of the system that will adopt a new technology. The technology has to be appropriate for a specific time and place.

3.7 Development, learning and innovation dynamics in the building sector

This last section discusses the development, learning and innovation dynamics in the building sector. The point of departure for the discussion is found in several articles exploring such dynamics in the building sector as well as how these impede or support the implementation of sustainable building and energy efficient building (Lovins, 1992; Lutzenhiser, 1994; Dubois and Gadde, 2002; Andersen et a., 2004; Nässén and Holmberg, in press).

To take a case in point, the advantage of energy efficient solutions that would mean economic savings are not for example a sufficient argument for the building sector to invest in such solutions (Lovins, 1992; Lutzenhiser, 1994). As argued by Lutzenhiser (1994 p. 868), innovation, organisation and technological changes are also socially regulated matters, and as such regulated by non-economic factors. Lutzenhiser argues that organisations seldom act solely on the basis of rational self-interest. He point to studies of economic behaviour that suggest that all forms of exchange are strongly influenced by social obligations and normative expectations. The behaviour of the organisation as well as its ability to innovate can instead be seen as influenced by a combination of cultural, institutional, socio-economic, and technical factors. This approaches theories of large technological systems by Hughes (see an introduction to theories by Hughes, 1987 in Lutzenhiser, 1994 and Kain, 2000). Hughes presents technological systems as both socially constructed and shaped by society. The change of technological systems involves several stages from invention, development, and adoption. Hughes recognizes the influence of momentum in a system dependent on organisation as well as people committed to various interests in the system that can offer resistance to change. Large-scale systems exhibit considerable momentum but evolve at uneven rates due to differences of interest and ways of thinking among the actors involved. Consequently, some innovations will be successful while others will fail.

The organisation of work

It can be argued that the building sector provides an optimal ground for technology diffusion through multiple connections and interfaces with different actors, technologies and practise (Dubois and Gadde, 2002; Andersen et al., 2004). In practice this represents a challenge, as potential adopters of new technology are risk averse and cautious concerning the cost and efficiency of changing established procedures. The prevailing short-term thinking in the building sector as well as the focus on the production has led to a concentration on small innovations with quick yield (Larsson, 1992; Ericson and Johansson, 1994). Moreover, initiatives taken by a single actor will meet resistance as this may challenge the effectiveness of existing networks. It could also lead

others to bear the risk for implementing new innovations. As already discussed in Section 3.3, the temporary project organisation creates uncertain relationships with respect to perceived benefits from joint development (Andersen et al., 2004).

Among other factors the prevailing short-term thinking can be explained by the building project often being considered as unique, and that a new project organisation is formed for every new project (Ericson and Johansson, 1994; Dubois and Gadde, 2002; Lutz and Gabrielsson, 2002). In such a system, either evaluations of product or process become valuable (Lutz and Gabrielsson, 2002 p. 14). The idea of the unique building project might be over-emphasized. Even if the building process is considered as unique it does contains repetitive parts. Furthermore, beneath the project management level the work consists of tasks and activities that are both repetitive and of a routine nature (Engwall, 1998 p. 30). Lutz and Gabrielsson (2002 p. 14) refer to The Egan report *Rethinking Construction* in the United Kingdom and state that about 80% of the activities that are part of the building process are the same in every project

Competition and risk aversion

Another factor mentioned in the literature is the lack of competitiveness in the building sector. The reasons for this lack are numerous (see for example Swedish Government, 2002:115). Here only a few of them are discussed.

The building sector is rather conservative and does not change its procedures. Even though the company stock changes in the building sector market, the products they offer or the techniques and procedures used do not do so (Lutz and Gabrielsson, 2002 p.8). Thus a renewal of the company stock does not lead to the introduction of new techniques, products or organisational forms. Consequently, productivity will develop more slowly in the building sector than in other sectors where existing and new companies need to innovate in order to be able to compete.

Furthermore, innovation is not economically defensible for first-movers and the building sector is characterised by static competition

(Lutz and Gabrielsson, 2002; Andersen et al., 2004)[36]. The actors are afraid of unknown costs and afraid to innovate in fear of damage to their reputation if alternatives fail (Lutzenhiser, 1994). The acting of the end-users is also special in the building sector as they have not been able to create incentives for change and innovation through market pressure. The end-users of buildings only have limited knowledge, and cannot see the feasibility, drawbacks and pay-offs and thus conservative in nature (Green et al., 1994 cited in Andersson et al., 2004; Nässén and Holmberg, in press).

Information and education

In such a system, as described above with low incentives for innovation, investments in research and development strategies for the future are not interesting (Lutz and Gabrielsson, 2002 p. 9). Nor is there any interest to employ highly educated personal. Consequently, the educational level among employees within the Swedish building sector is low in comparison with other sectors (Nutek, 2000[37] quoted in Lutz and Gabrielsson, 2002; Swedish Government, 2002:115). The same observations have been made in the Netherlands (Pries, 1995 quoted in Femenías and Hal, 2003). This also affects the level of interest in research and development. In Sweden not more than 1% of the annual turnover in the building sector is invested in research and development projects (Miljövårdsberedningen, 2000).

Another factor that strongly contributes to contemporary problems in the sector is that existing knowledge is not used (Swedish Government, 2002:115 p. 228). Although there exist many articles, research reports etc. the actors in the building sector have the impression that there is a lack of accurate knowledge. The knowledge is strongly fragmented, not easily accessible and many actors experience difficulties in getting an overview (ibid). Lutzenhiser (1994 p. 872) points to the need for a better understanding of how technical information is generated and disseminated. A parallel can be drawn with the debate on the sick-building syndrome of the 1980s. The problem with the sick-building

[36] For a more detailed description of competitiveness and development in the building sector see Swedish Government, 2002:15.
[37] "Svenskt näringslin på rätt väg?" Appendix 3 in investigation 1999/2000 published in Swedish Government 2000:7

syndrome depended to large extent upon the fact that important existing knowledge about health-risks, materials and building methods did not reach the actors in the sector (Ericson and Johansson, 1994 p. 31; Lundequist, 1995b p. 9). As pointed out by Ericson and Johansson, actors in the building sector rely on their own experience in situations when information is missing or difficult to access.

Contextual factors

As already stated, the building sector is regulated by political objectives as well as by fiscal systems, regulations and laws. The building sector is also dependent on the loaning institutions, and thus indirectly upon larger financial systems (Lutzenhiser, 1994 p. 873). Furthermore, for example, energy prices will be either motivating or discouraging for energy-efficient innovations (Lovins, 1992; Lutzenhiser, 1994; Nässén and Holmberg, in press).

An important issue that affects the diffusion of innovations in the building sector is the cyclic nature of demand (Lutzenhiser, 1994 p. 871; Andersen et al., 2004 p. 353). For example, the building sector in being the second largest industrial sector in Sweden has an important role in the national economy. For this reason it has been used for labour market policy measures. The cyclic and unpredictable nature of demand and supply affect the innovation capabilities of the building sector.

3.8 Summing up

The Chapter has presented a general description of the building sector, the structure and the organisation of work, mainly based on Swedish circumstances, as well as the specific conditions for development, learning and innovation within this sector. The building sector is a large societal sector within the European Union with considerable importance for the national economies of its member states. The building sector is largely national, diversified and fragmented.

Knowledge in the building sector is mainly developed through the practice, through the construction of projects. This empirical-practical knowledge building process is not systematic or controlled by scientific methods. It is subjective and contextual. The knowledge build-up, as well as all changes, in the building sector is usually characterised as

being slow and taking place in small incremental steps. Knowledge building is a long process of planning, construction, evaluation and feedback, which can take many years from start to results. Several factors challenge the efficiency of the knowledge build-up within the building sector. One factor is the temporary nature of the building project, which has no organisational memory. The building project is usually considered as a unique event, and there are seldom long-term relationships between actors. A second factor is the fragmentation of the building process involving actors from different professional cultures. The fragmented building process has several clearly defined phases and knowledge is lost as actors in the project team enter and exit the process during its course. A third factor is the decentralised decision-making process and the ad-hoc problem-solving on the spot, which does not encourage long-term thinking. A fourth factor concerns the individual actor's interest and attitude to learning.

This chapter gives an introduction to professional knowledge as the ability to function and act in a professional praxis. All members of a professional group are collective bearers of praxis. Some of the rules in praxis are explicit, while other will remain implicit or tacit. Professional knowledge can be characterised as an approach to problem-solving in which the rules cannot be explicitly explained but taught through practice. As pointed out by Rolf (1991 quoted in Ericson and Johansson, 1994), a profession can become so intimate with an activity that it will hide the real conditions. Rolf calls this the confidence trap. Furthermore, a distinction is made between information and knowledge, where knowledge is information that has been interpreted by a human and transformed into living knowledge. The practical and concrete example has an important role in the transmission of professional knowledge. In the case of knowledge about buildings and architecture, the built example is necessary, as such complex artefacts cannot be understood other than as comprehensive units.

The building sector consists of organisations that will learn and develop while reacting to their environment. As it can be difficult to access or acquire complete information about the environment regarding economic, technical or social phenomenon, the organisation can find it safer to persist with old routines. It can be argued that organisations in insecure situations when objectives are ambiguous or uncertain develop

through imitating other organizations they find successful or normative (DiMaggio and Powell, 1983).

Organisational learning is dependent on the individual learning. In a small organization, organisational learning and individual learning is the same amounts to the same, but in larger organisations, experience must be diffused between individuals in the organisation. These forms for disseminating experiences can be informal in person-to-person contact or formal in written sources etc. A study by Bröchner et al. (1991) shows that construction firms in Sweden use formal systems for internal learning, while consultant and architectural firms use informal person-to-person methods. The organisational learning model by Argyris and Schön (1996) distinguishes between single-loop learning and the more radical double-loop learning that also involves changes in theory-in-use, those values and ideas (often tacit) on which the organisation has based its activities. The authors point out that the theory-in-use is often counterproductive for double-loop learning.

The organisation can learn either by gaining their own experience or by using experience gained by others. Rogers (1962) make a distinction between the diffusion process, which aims at spreading a new idea, or the innovation and the adoption process, which involves adopting and using a new idea or innovation. Essential parts of these processes are the innovation and the communication of this innovation in a social system over time. Rogers further argues that there are five stags in the adoption process: awareness, interest, evaluation, trial and adoption. He also distinguishes between different categories of potential adopters from innovators, early and late adopters to the ‘laggards’. The innovators are venturesome, cosmopolitan, less dogmatic and search for first hand information. The ‘laggards’ are those that will adopt last. The ‘laggards’ are those most influenced by opinion-leaders and personal communication in order to adopt. However, the personal communications are most important in the later phases of adoption. The awareness of innovations is mainly cared for by impersonal sources such as the media. Finally, Rogers points out the importance of a change agent or change agency for the communication of innovations.

The chapter is concluded by a discussion of a few features that will challenge the innovation and learning dynamics in the building sector. One important factor is the short-term thinking in the building sector that

can be attributed the organisation of work within the sector with temporary and unique building projects. This short-term thinking has also lead to a course of development via small innovations providing a quick yield. Furthermore, organisations in the building sector are characterized as being averse to taking risks. Another feature is the low competitiveness in the building sector. There are few incentives for innovations in order to be competitive and the end-users have limited knowledge of the process and the product and to date do not exert any market pressure for change. This lack of competitiveness can be seen as one factor that influences the limited interest in research and development within the building sector. Consequently, the formal level of education in the sector is low in comparison to other societal sectors. The actors within the building sector seldom read existing research. The building sectors actors usually find research and information as being fragmented and difficult to access. In situations where there are shortcomings in information the actors tend to rely on their own personal experiences.

Finally, a number of contextual factors will influence the innovation and learning dynamics of the building sector, such as the highly cyclical demand within the sector, the fiscal systems, building regulations, political directives, determination of prices etc.

Chapter 4 The Demonstration Project and the Building Experiment

This chapter provides a state of the art on research about demonstration project and building experiment. First, the terminology for demonstration projects and building experiments are derived both etymologically and through the application in the literature. Second, earlier experiences and empirical studies of demonstration projects and building experiments mainly in Sweden and the Netherlands are presented.

The sources for the chapter are found among literature on experiments and demonstration projects concerning building activities (excluding engineering work, and urban systems and structures). Only demonstration projects and building experiments relating to sustainable building and the key indicator energy are referred to.

Building experiments exists since earlier in the Swedish building history[38] but the development accelerated remarkably with the 1973 oil crises (Holm, 1978; Bröchner and Månsson, 1997). Governmental support has in Sweden, according to Holm and Bröchner and Månsson, mainly been given for experiments and demonstrations in the energy field. Similar activities with experiments as a part of a political strategy to promote energy efficient building could be observed in other countries. The United States and Canada were first and in Europe Germany, France and Austria were ahead of Sweden in particular concerning solar technique (Bröchner & Månsson, 1997 p. 11).

[38] Cronsted's tiled stove (kakelugnen) was tried as an experiment in the Stockholm castle the winter 1766/77 and was found using half the wood used in other conventional heating system at that time (Bröchner & Månsson, 1997). During the post-war period a political program was set up to fulfil the need for housing. The so-called machine-loan-fund (maskinlånefonden) preceded later experimental funds and was set up to rationalize the building process. In the 1950s there were still scope for qualitative experiments in housing while the 1960s were focused on quantitative production. The housing production diminish during the 1970s and with that the interest in building experiment (Holm, 1978).

4.1 Etymological explanations

The term experiment can be explained as to test (a trial), a tentative procedure or policy or as (Merriam and Webster's Collegiate Dictionary on line, www.m-e.com, November 2003):

> …an operation carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law.

An experiment is thus an operation or process carried out to resolve an uncertainty.

The word 'demonstration' as a noun dates to the 14th century and can be explained as (Merriam and Webster's Collegiate Dictionary on line, www.m-e.com, November 2003):

> …an act, process or means to demonstrating to the intelligence: as a (1)**:** conclusive evidence: proofs (2)**:** derivation b**:** a showing of the merits of a product or service.

A demonstration is an outward expression or display. The word originates from the Latin 'demonstratus', a combination of 'de' and 'monstrare' (to show). The meaning of 'demonstrate' is (Merriam and Webster's Collegiate Dictionary on line, www.m-e.com, November 2003):

> …to show clearly; to prove or make clear by reasoning or evidence; or to illustrate and explain especially with many examples.

Synonyms for 'demonstration' and 'demonstrate' are 'exhibition' and 'show'.

The use of the word 'project' dates according to Webster's Collegiate Dictionary on-line back to the 15th century. Etymologically the term originates from the Latin, neuter of 'projectus', past principle of 'proicere' to throw forward combining 'pro' and 'jacere' (to throw). According to Engwall (1998) the modern use of the term 'project' originates from the cold war[39]. The traditional concept that denoted a

[39] The French philosopher Jean Pierre Boutinet has in his "Anthopologie du projet" (1996) (cited in Lundin & Midler, 1998, p. 234) traced the project notion in history. He shows that its modern meaning is rather recent: the Greeks and Romans had no equivalent. Based on Latin the XIV century French words 'pourjet' or 'projet' named architectural elements in

proposed idea or object then became subordinated to the new concept, which emphasizes the process of realising an idea or objective.

So where the experiment defines a process in which a hypothesis is tried out under controlled conditions, the demonstration project is to show clearly or to illustrate and explain. Neither the term building experiment nor the term demonstration project can be completely derived in an etymological way. Instead the meaning has to be found in its application.

4.2 The research and development chain

Earlier research point out the necessity of building experiment and demonstration projects as part of innovation and development in the building sector (see for example Holm, 1978; Levón, 1986; The Swedish Energy Research Comission, 1987; ByACTH, 1990:1; ByACTH, 1992:2; Edén ed., 1992; Byggforskning 1992:4; Buijs and Silvester, 1996; Jensen, Elle & Jensen, 1998; Hal, 2000). In his study of building experiments in the Nordic countries Levón (1986 p. 7) finds that:

> Experiments and product development is organically linked to building planning and construction...[40]

The former director of The Danish Building Research Institute, SBI, Philip Arctander makes the same conclusion (ByACTH, 1990:1 p. 35):

> Without experiments no development.

Arctander emphasizes that this does not mean that all building experiments lead to progress. An experiment can also lead to a sidetrack or a dead-end but then at least these paths can be excluded from further attempts.

The experiment and the demonstration project are seen as necessary parts of a chain from development of new technique and concepts to the diffusion of the same in the building sector (Figure 4.1). The experiment

front (as balconies). Boutinet has in studies of the history of architecture found the beginning of the modern project precisely when Brunelleschi separated the design from the execution of the building. The architectural project had for the first time won autonomy from the realisation against the medieval tradition where the architects' role was not separated from that of the chief of the construction.

[40] Experiment och produktutveckling hör orgnaiskt samman med byggplanering och byggande. (Levón, 1986 p. 7)

is followed by a demonstration project in the last stage before the diffusion. According to The Swedish Energy Research Commission[41] (1987 p. 33) the demonstration cannot be accomplished until the second or the third full-scale trial plant:

> There is an obvious risk that the first full-scale plant leads to a negative demonstration, i.e. that a technique that in due time could function well gets a bad reputation[42]

Also Dutch researchers Buijs and Silvester (1996) emphasise hat experiments should be clearly distinguished from demonstrations in order to avoid exposition of innovations not reliable for introduction.

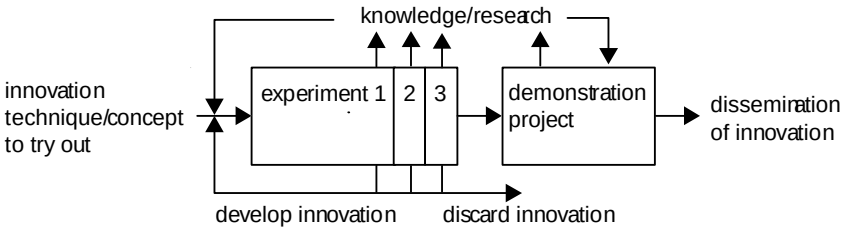


Figure 4.1 The research and development chain (adopted after The Swedish Energy Research Comission, 1987 p. 10)

Some authors point out the fact that the research and development chain is seldom chronological or linear in the building sector[43] (Rudberg and Winqvist, 1990 p. 25; Bröchner and Månsson, 1997 p. 19). The research and development chain can give the idea that research is a driving force for development, while instead development is usually triggered off through the search for problem solutions in practice (Rudberg and Winqvist, 1990 p. 25). Futhermore, there is need for continuous evaluation, and revision of objectives, techniques and concepts through the whole chain of development (Bröchner and Månsson, 1997 p. 19). The fact that the chain is seldom chronological can explain why the

[41] In Swedish: Energiforskningsnämnden
[42] "Det finns istället en påtaglig risk att den första fullskaleanläggningen leder till en negativ demonstration, dvs att en teknik, som så småningom fungerar väl, får dåligt rykte." (Efn, 1987 p. 33)
[43] Research in the medical field is closest to the theoretical picture due to pressure from authorities on a well-organized procedure for registration of new medicines. (Bröchner and Månsson 1997 p. 19)

definitions of, and motivations for, building experiments given in the literature approaches the ones given for demonstration projects.

4.3 The building experiment

The Danish Building Research Institute concluded some characteristics for building experiments in the 1980s (ByACTH, 1990:1 p 34): 1): The client should be prepared to try something new; 2) The experiment will involve extra costs; 3) The experiment should be made in connection to a real building project; and 4) Emphasise should be set on the follow-up and evaluation.

In a retrospective of building experiments in the Swedish Journal for Building Research, Ekemar (1992a) points out several purposes for building experiments:

- To mobilise good forces among researchers, architects, clients, and builders.
- An instrument for a dialogue between research and practice.
- Demonstrating and trying new technical solutions in full-scale.
- A pedagogical tool and medium for information that attract the attention over a long period.
- Shortened time period between development and practical implementation.
- Decreased risk for the spread of unsuitable technical solutions.

Several authors point out the importance of clear objectives in building experiments (Holm, 1978; ByACTH, 1990; Edén ed., 1992). Arctander (ByACTH, 1990:1 p. 37) emphasizes that building experiments also must serve a desirable vision of the future:

> An experiment demands first of all that you do something different but in addition that there are clear objectives.

According to Holm (1978 p. 5) this ‘different’ has to be accompanied with a hypothesis about something better, a hypothesis that should be tested in the experiment. Holm state that the experiment, as method, should be applied when there is no other way of obtaining knowledge than through a full-scale trial. Moreover, this full scale experiment should have a clear hypothesises and an evaluation plan (Holm, 1978).

Many other authors emphasizes on the importance of evaluations, post-hoc evaluations, and repeated post-occupancy evaluation in building experiments (for example The Swedish Energy Research Comission, 1987; ByACTH, 1990; Edén ed., 1992).

In the report *Warning – experiment!* (Edén ed., 1992), the authors conclude that the building experiment has two values: to show and to prove. Edén et al. further note that when involving in an experiment one should not be afraid of the unknown. Caldenby (1992 p. 16), states that the etymological derivation of the term experiment is close to the words 'danger' and 'experience'. Gromark (1992 p. 13) finds that an experiment is a demonstration project with higher ambitions than usual. Even so, the search for something new should not be an end in itself.

Another issue brought up by Edén et al. is the importance of 'soft' measures in building experiments such as quality of life, identity, and sensuous experiences. Even though these values can be difficult to measure in an evaluation they are important ingredients to consider in the set up of an experiment (Edén ed., 1992).

Finally, as brought up by several authors, an experiment involves an economic risk for the project owners. In the case of government supported experiments there is usually some kind of risk protection for the project owners (The Swedish Energy Research Comission, 1987; Bröchner and Månsson, 1997).

4.4 The demonstration project

Whereas the term demonstration project[44] is increasingly used in the discourse of sustainable building the term experiment is seldom mentioned (see for example VROM, 1997; Sustainable Building: Frameworks for the Future, 2000; Miljövårdsberedningen, 2000; Rethinking construction, 2002; The Swedish Environmental Protection Agency, 2003; WGSC, 2004). 'Demonstration' is often seen as one characteristic in building experiments (see for example Levón, 1986; Ekemar, 1992a) while the 'experiment' is totally absent in the discourse

[44] Beside the term demonstration project we find a range of kindred concepts. The term 'pilot project' should be interpreted as a first project or trial in a chain of experiments or demonstrations (Efn, 1987). 'Front-line project' should indicate a project with the ambition to be in head of the development. For example, the ambition for the front-line project Hammarby Sjöstad in Stockholm was to use the most environmentally adjusted approach available at Website: www.stockholm.se/politik/dokument/98/utlatanden/arkiv/U98004.htm

of contemporary demonstration projects for sustainable building. Sjökvist, responsible for the development at the Swedish Construction Federation in the beginning of the 1990s, finds that the word experiment gives negative associations to energy experiments with bad results (Ekemar, 1992b). Caldenby (1992) also points out the problem that with what he sees as 'extraordinary' building experiments difficult to reproduce.

Several authors point out the demonstration project as as a way to introduce new ideas and prepare for the diffusion on the regular market, thus acknowledging the research and development chain presented in Figure 4.1. Dutch researchers Buijs and Silvester (1996 p. 196) give the following definition of demonstration project:

> …a project in which innovative technologies are being used in more or less normal situations to foster the development and diffusion in the regular market of these technologies.

The United Nations Human Settlement Programme has made a description of demonstration project as a tool for development. The United Nations Habitat Programme presents the following characteristics for demonstration projects (website: http://www.unhabitat.org/cdrom/governance/html/dp.htm, November 2003)[45]:

> A demo project provides the means to introduce and experience innovative ideas and approaches and prepare the way for replication and up-scaling. /…/ A demo project shows in practice how a particular problem may be addressed. It facilitates the replication and up-scaling of an action through visible accomplishments and lessons of experience. /…/ Demonstration projects show case approaches and solutions that can inspire and further catalyse change.

[45] The cited document is based upon the following documents: 1) Formulating Issue Specific Strategies and Action Plans, Volume 4 of the SCP Source Book Series, UNCHS & UNEP, Nairobi, 1999.; 2) Establishing A Demonstration Project Clearing House, Draft Concept Paper, written for use in the Philippines, SCP UNCHS/UNEP, 2000 (Unpublished); 3) Sustainable Chennai Project: Documenting Experiences and Drawing Lessons of Experience from Environmental Planning and Management Application in Chennai; A documentation prepared for UNCHS, CMDA and UNDP, April 1999; .4) Implementation and Replication of the Sustainable Cities Programme Process at City and National Level: Case studies from Nine Cities; Working Paper No. 2, SCP, UNCHS, Nairobi, March 2001; 5) Framework for organising neighbourhood - based Demonstration Projects

The European Working Group Sustainable Construction Methods and Technique (WGSC, 2004 p. 17) promoted demonstration projects for development of sustainable building with as it is:

> an important means of disseminating concepts, ideas and solutions to promote the acceptance, implementation and replication of sustainable construction methods and techniques, predominantly within the local context of the building.

The WGSC finds that the demonstration project should be a reference that proves that proposed construction methods and techniques live up to their promises.

American researchers Keating and Peach (1989) point out the advantages of demonstration projects, compared to simulations, in giving real world data. Keating and Peach (1989) give the following advice for the successful demonstration project:

- The objectives must be clearly laid out in advance, be agreed upon by all parties, and measurable.
- Demonstration projects must be well designed so that results will be scientifically defensible.
- The project should be carried out in an open public manner so that all parties recognize that it is a fair test.
- The research should be designed so that the most information can be obtained without overloading the project with conflicting objectives. The authors propose a balance between 'learning as much as possible' and overloading the project with research objectives.
- Furthermore, a good demonstration project will carefully collect and maintain a good database to be used for answering unanticipated future questions as well as to serve as a resource for planning similar projects. The authors further propose that the research should be continued beyond the time of the actual demonstration project and that the lessons should be communicated, the success as well as the mistakes.

Most authors in the literature (Keating and Peach, 1989; Buijs and Silvester, 1996; UN Habitat, 2003; Hal van, 2000) insist on the value of evaluation and repeated post-occupancy evaluations of demonstration

projects. Keating and Peach (1989) and The United Nations Habitat Programme emphasize on an 'open' and public character of a demonstration project. The United Nations Habitat Programme emphasizes that the demonstration projects should be designed from the beginning to serve as demonstration. Furthermore, the United Nation Habitat Programme puts forward the special character of the demonstration project (http://www.unhabitat.org/cdrom/governance /html/dp.htm, November 2003):

> All demonstration projects are projects, but not all projects are demonstrations.

The political strategy

Besides developing new ideas and inspiring for change, Buijs and Silvester (1996) point out the use of demonstration projects as an instrument to implement and test new policy in the field of sustainable building. Moreover, results from demonstration projects provide a basis for new building regulations (Buijs and Silvester, 1996; Sustainable Building: Frameworks for the Future, 2000)[46]

In general, private or governmental authority can use three kinds of steering instrument: 1) constraint/regulation, 2) reward-penalties, and 3) information (Etzioni, 1975 cited in Hanberger et al, 2002). Constraint is a stronger form of steering instrument than rewards, which in terms are stronger than information. All three categories can be subdivided in positive and negative instruments expanding the map of possible instruments[47], Table 4.2 (Bemelmans-Videc et al., 1998 cited in Hanberger et al., 2002).

[46] This is also mentioned as motivation for the European demonstration programme 'Thermie': http://europa.eu.int/comm/energy/en/thsumary.htm (July 2003)

[47] The authorities (private or governmental) can also choose *not* to actively intervene and let the development depend on: 1) democratisation (the public get increased knowledge and power to formulate objectives and to carry these through), 2) the market (let the economy guide the development 3) jurisdiction (juridisering) (the responsibility is left to legislation), or 4) experts/technique (let experts define problems and solutions and to develop new technical)[47] (Hanberger et al., 2002).

Table 4.2 Six kinds of possible steering instruments for authorities (after Bemelmans-Videc et al., 1998 cited in Hanberger et al., 2002).

Instrument	Positive	Negative
Regulation	Instructions	Prohibitions
Economical	Subventions	Taxes/charges
Information	Encouragement	Warnings

In this context demonstration projects may be seen as a positive instrument in the information category. Buijs and Silvester (1996) find demonstration projects along with covenants, communication and network management to be 'second generation steering instruments'. Where classical instruments, such as legislation, mostly fall short concerning the complex questions of sustainable building, Buijs and Silvester argue that the second generation steering instrument manage barriers encountered by the government (cf. Nutek, 1993a/b). The demonstration project will be appealing to an offensive strategy among actors in the building sector whereas a defensive strategy would need other kinds of instruments such as regulation. Accordingly, the demonstration project would mainly sustain the 'front-runners' while regulations are needed for the 'laggards'[48] (compare to the innovation-diffusion theory in section 3.6). The strategy for development proposing building experiments and demonstration projects are usually slow processes with successive changes (Nutek, 1993a).

4.5 Experiences from building experiments and demonstration projects in Sweden

In Sweden, several evaluations of government supported experimental programmes in the energy field have been carried out (The Swedish Energy Research Comission, 1987; Rudberg and Winquist, 1990; Nutek, 1993a; Nutek 1993b; Bröchner & Månsson, 1997). These evaluations show that investments in building experiments result in positive

[48] According to a report from United Kingdom (quoted in CIB, 1999 p. 95) can actors within the building sector take four types of strategies towards sustainable building, on a gradual scale: defensive, offensive, eco-efficient, and sustainable[48]. The defensive strategy has lowest levels of innovation towards sustainable building and need building regulation as

advancement for energy efficient building and the introduction of renewable energy resources. For example, The Swedish Energy Research Commission concludes that successful experiments for energy-efficient buildings have accelerated the introduction of new energy technologies in Sweden with three to five years[49] (The Swedish Energy Research Comission, 1987 p. 11). Moreover, in a few of the 15 cases studied by The Swedish Energy Research Commission unsuitable technology have been identified and discarded. Rudberg and Winqvist (1990) in their evaluation of experiments in the energy field found that over 40% of the completed projects have given results that are actually applied or are ready for implementation. The authors state that few experiments have lead to technical leaps or commercial success. Instead, the experiments have the character of successive achievements through persevering improvements (cf. Nutek, 1993a). Such successive achievements are common in all innovation in the building sector (see section 3.6).

Although claiming positive results, Swedish Energy Research Commission (1987) finds that the accumulation of knowledge, documentation, and dissemination of information varies considerable between the experiments. Other evaluations confirm the weak points in the dissemination of results from the experiments to mainstream building (Nutek, 1993a; Bröchner and Månsson, 1987). Bröchner and Månsson (1987 p. 10) refer to an earlier government communication (Swedish Government 1974:72) that concludes that:

> …valuable research results have not come to practical implementation due to deficiencies in resources for information about and practically demonstrations of advancements that have been made[50].

The Swedish Energy Research Commission (1987) points out the double function of the full-scale experiment. On the one hand the full-

steering. The sustainable strategy has the highest involvement in sustainable development based on insight and responsibility.

[49] It is underlined that the support for experiments was part of a larger package of energy political measures.

[50] "…värdefulla forskningsresultat [har] inte kommit till praktik användning beroende på bristande resurser att informera om och I praktiskt bruk demonstrera de gjorda framstegen." Swedish Government 1974:72 as quoted in Bröchner and Månsson, 1987 p. 10.

scale experiment serve as source for empirically based knowledge about new techniques. On the other hand the full-scale experiment forces the introduction of these new techniques on the market. These two functions for the full-scale experiment are often found to concur (cf. *Planera, Bygga, Bo*, 1989; Keating and Peach, 1989). An article in the Swedish trade press periodical *Planera, Bygga, Bo* (1989) points out the difficulties in achieving satisfactory results both in knowledge build-up and in the diffusion of innovations in the same project. The author of the article in Planera, Bygga, Bo advocates knowledge build-up to be the most important in experiments and demonstration projects and not primarily the introduction and commercialisation of new technique on the market. American researchers Keating and Peach (1989) have found that when commercialisation is in focus for demonstration projects the knowledge build-up tends to become neglected.

Bröchner and Månsson (1997) in their study of Swedish building experiments that received support from The Swedish Council for Building Research, BFR, in the period 1977 to 1994, found that the diffusion of innovations is dependent on technique. For example, the diffusion of heat pumps and solar energy[51] has showed good results while other techniques have had difficulties entering the market. However, Bröchner and Månsson point out the difficulty in clearly establishing the effect of building experiments as many experiments also have had the advantage of other kinds of subventions (Bröchner and Månsson, 1997 p. 7). Moreover, Bröchner and Månsson found that diffusion of results to mainstream building from experiments carried out in individual project, for example in single villas, where the owner has been the project initiator is negligible.

Svane and Wijkman (2002) have in a recent report concluded lessons made from two recent influential demonstration projects of sustainable building in Sweden (Understenshöjden and Ekoporten, see also section 8.2). The authors claim that the projects have been important in the continued development of sustainable building in Sweden. Not least in showing the importance of investing in the social dimension for moving towards sustainable development. In the example of Ekoporten, the project owners have explicitly used their experiences in continued activities.

[51] Solar energy is being spread today after a long chain of successful experiments.

Several authors in the studied literature are in favour for a continued investment in building experiments. However, they advocate enhanced organisation of the projects and enhanced dissemination of results (The Swedish Energy Research Comission 1987; *Planera, Bygga, Bo*, 1989; Rudberg and Winquist, 1990; Ekemar; 1992a; Nutek, 1993a; Bröchner and Månsson, 1997). Bröchner and Månsson propose a continuation of building experiments initiated and carried through by an organisation that is not related directly to sector authorities, the industry or the research community. They further propose an expert group to be connected to the project in order to identify and reduce risk in investments. They also find it important to have a municipal connection in order to facilitate for the dissemination of results.

4.6 Experiences from building experiments and demonstration projects in the Netherlands

According to the Dutch researchers Silvester and Kruijssen (1996 respectively 1999 in Hal van, 2000, p. 9) experience shows that many environmental innovations in the Netherlands are only diffused through demonstration projects. Application without a demonstration project is often left out.

Buijs and Silvester (1996) in their research on effect from building experiments and demonstration projects refer to a series of successive projects with ‘high energy efficient housing’ that took place in the Netherlands between 1980 and 1986. Results from these energy demonstrations show a 25% reduction of energy use. As in the Swedish building experiments there have been weaknesses in the reproduction of results in mainstream building. Buijs and Silvester (1996 p. 199) state that there has been an effective information transfer from one demonstration project to the next in cases where the group of involved actors were almost unchanged. However, hardly any effects could be observed on mainstream building practice. The authors state this to be a problem on the one hand of responsibility within governmental organizations and on the other hand due to information transfer not being targeted.

Problems with dissemination and reproduction of results from these earlier building experiments were according to Buijs and Silvester

(1986) corrected in *Ecolonia*, the first national demonstration project for sustainable building in the Netherlands (Picture 4.3). In Ecolonia an information centre was set up early. Although, Buijs and Silvester state that no direct diffusion of the design concepts used in Ecolonia can be noticed, a number of technical innovations like water-saving equipment, passive solar energy, and higher insulation were soon implemented in mainstream Dutch building. The effect of Ecolonia as demonstration project could be observed only three years after the completion whereas the effect of the earlier high-energy efficiency programme was delayed up to 15 years (Buijs and Silvester, 1996 p. 201). However, as in the earlier demonstration projects the networks and organisations around Ecolonia fell apart after the completion of the project and the closing up of the information centre.

Picture 4.3 Ecolonia, Alphen aan den Rijn, The Netherlands. The first national demonstration project for sustainable building in the Netherlands from 1991.

The national demonstration project programme 1996 – 1999

In the Netherlands a national demonstrations programme for sustainable and energy efficient building was carried through from 1996 to 1999 with the main objective to (Sustainable Building: Frameworks for the Future, 2000 p. 7):

> Build examples of the possibilities available in the field of sustainable building showing what is projected to become standard over a few years.

The demonstration projects were to contribute to the broadening of the perspective of sustainable building and altogether 47 demonstration projects (31 housing projects and 16 non-residential projects), spread over the country, were completed and monitored. According to Remkes, the former Dutch State Secretary for Housing, Spatial Planning and the Environment these demonstration projects *"…have become an enormous success."* (ibid p. 3). Remkes point out that the demonstration projects have with their quality and user comfort demonstrated that:

> …sustainable building is possible and that it is also practicable, affordable and marketable.

Moreover, Remkes points out the wealth of know-how and experiences that have been acquired through the demonstration programme.

The Dutch demonstration programme focused on the value of demonstration projects to make sustainable building visual and tangible using the motto '*To see is to believe*' (ibid p. 9). According to Remkes this point also been successful (ibid p.3):

> Sustainable building has become not only a familiar, but also a tangible concept in the Netherlands.

Though claiming positive results from the demonstration programme, many improvements can be made. The demonstration projects are merely claimed to be guiding for continued development in the country (ibid p. 9). A number of measures in the demonstration projects have become standard in Dutch construction: measures for energy efficiency, low-energy heating boilers (natural gas), and wood from managed resources. Still, most sustainable building measures[52] have not become embedded in mainstream construction and further investments are needed. Former State Secretary Remkes concludes that with the experiences from the demonstration programme the Netherlands can continue to the next step, the implementation of sustainable building on a large scale (ibid, 2000 p. 3). However, at the moment the development

[52] As defined by the Dutch National Sustainable Building Package.

of sustainable building is receiving less political support in the Netherlands also for demonstration projects (see section 2.7).

4.7 Evaluation and dissemination of results

Experiences in Sweden, in the Netherlands and elsewhere claim important deficiencies both in evaluation and in dissemination of results from building experiments and demonstration projects (The Swedish Energy Research Comission, 1987; Rudberg and Winquist, 1991; Nutek, 1993a; Buijs and Silvester, 1996; Jensen, Elle & Jensen, 1998; Hal van 2000; WGSC, 2004). The value of evaluations for the continued development cannot be underestimated. Several authors propose that documentation, follow-up and reporting should be *formalised* in order not to be neglected in these work intensive projects (The Swedish Energy Research Comission, 1987; Nutek, 1993a; Bröchner and Månsson, 1997). Buijs and Silvester (1996) as well as Bröchner and Månsson (1997) emphasize on the importance to expose not only successful results from building experiments and demonstration projects but also negative results. Buijs and Silvester (1996) further point out the risk in holding on to a positive image of the demonstration project. In one of their cases the project owners persisted in a positive image which resulted in a conflict with the inhabitants whose complaints were not recognised.

Buijs and Silvester (1996) find that the long run effect of demonstration projects never has been systematically identified. Studies have never lasted longer than two heating seasons. Swedish evaluations of building experiments also show that measurements have been made during only a few years (Levón, 1986). One explanation could be that national organisations providing loans and subventions for the experiment need quick reporting of results.

Some authors propose international co-operation and synchronization of demonstration projects and standardization of evaluation methods to facilitate information exchange (Nutek, 1993a; Buijs and Silvester, 1996; Bröchner and Månsson, 1987; Hal van, 2000). The Swedish Energy Research Commission (1987) points out the importance of independent evaluations.

The Swedish Energy Research Commission brings up the question of financing evaluations and dissemination of results. The Swedish Energy Research Commission estimates that initial studies, evaluations etc. often reach the same cost levels as the actual investments for innovations. This would justify that research and development in the experiments and demonstrations would need funding of the same magnitude as funding for investments (The Swedish Energy Research Comission, 1987 p 8).

The Swedish Environmental Protection Agency (2003) in their empirical study has found that information from demonstration projects or 'best practice projects' seldom is targeted. The existing collection of best practice examples is not customized to fit a certain target group. The information is driven by supply rather than by demand. Hal from the Netherlands confirms that information presented from many Dutch demonstration projects for sustainable poorly corresponds to the demand of the users (Sustainable Building: Frameworks for the Future, 2000 p.35):

> Knowledge transfer is an important part of the Demonstration Project. The only thing I'm afraid of is that the information corresponds poorly with the needs and demands of the users. Much is merely picture-perfect hot air, presented with care. Clear and instructive information designated for specific target groups is rare.

The need for change agencies

As brought up by The Swedish Energy Research Commission (The Swedish Energy Research Comission, 1987), the dissemination of information and reproduction of innovations and ideas from building experiments and demonstration projects can be referred to an internal and an external process (Table 4.4).

Table 4.4 Variables for analysis of result of experiments (The Swedish Energy Research Comission, 1987 p. 8).

	TECHNIQUE (Hard ware)	**KNOWLEDGE** (About the technique)
INTERNAL	Verification about use of the application	Knowledge build-up
EXTERNAL	Diffusion of technique or application	Knowledge dissemination

The important role of both internal and external dissemination of information can be attributed a kind of 'ambassadors' or change agencies[53] (Nutek, 1993b; Buijs and Silvester, 1996; Hal van, 2000). The Swedish Business Development Agency (Nutek, 1993b) points out the network of involved actors from different areas as having the role of change agencies. The involved actors will bring their experiences back to their 'home' organisation and into new projects (cf. Lundin and Söderholm, 1994, section 3.3).

The Swedish Energy Research Commission recommends that administrators of governmental support programmes play an active role in feedback of knowledge. Their undertakings should include: independent evaluations, quick reporting of results (as soon as there is significant new knowledge), the forming of expert groups to monitor progress and to give advice, and financial support for extra planning, monitoring, evaluation and dissemination of results. Bröchner and Månsson (1997) find it important that the change agency is an independent organization, not directly involved in the project or in the financing of the project. An example of a change agency of this kind could be the former Swedish Council for Building Research and the Universities. Hal (2000, p. 44) points out the importance that information is targeted, credible and that it 'speaks the language' of the user.

4.8 Conditions for transferring experiences

Several authors refer to difficulties in reproducing findings and experiences from successful experiences and demonstration projects in mainstream building (Buijs and Silvester, 1996; Hal, 2000; WGSC, 2004). Silvester (1996 cited in Hal, 2000 p. 42) concludes that a number of developments in Dutch demonstration projects for energy saving have not been fully worked out in follow-up projects. On the one hand, a good result was not proof enough for products to be re-applied, and some successful products even vanished from the market. On the other hand, products having negative results in test were re-applied and even so products that at earlier stages had been rejected. In many cases Silvester could not find any clear cause for this although financial advantage for

[53] Change agency is the term of Rogers (1962) see section 3.6.

some innovations could be concluded to have an importance for the diffusion. Buijs and Silvester (1996) in their study point out the lack of change agencies as one hindrance for the transfer of results. As already mentioned, Buijs and Silvester have found that transfer of experience functioned when the same actors joined in a follow-up project. Accordingly, one can say that the internal learning processes worked better than the external diffusion.

Economic conditions for innovations as well as the organisation of the information transfer are two important factors for diffusion of experiences and results. However, they are not the only factors for the up-scaling and reproduction of results from demonstration projects. Rudberg and Winqvist (1990) mention a few other factors from a Swedish perspective: political strategies, conditions for experimental loans and subventions, and building regulation. The WGSC (2004 p. 17) has found that demonstration projects carried through within the European Union has not yet reached the desirable impact. One of the main reasons mentioned is that cultural and aesthetic dimensions for the built environment have not been taken in account in the selection of demonstration projects. The WGSC find that neglecting such dimensions can lead to negative demonstrations, i.e. that demonstration projects risk becoming references for what *not* to do. The WGSC also find that strive for novel and unusual solutions in demonstration projects, as a mean in itself, can damage the demonstrational effect.

Hal (2000 p. 145), referring to research in the Netherlands as well as in several other European countries, distinguishes four factors that will be of importance for the diffusion of environmental innovations: 1) The quality of the innovation, 2) The organisation of the project, 3) The organisation of the information transfer, 4) and government policy. Apart from these factors, Hal finds that there are external factors beyond the influence of the project organisation such as international agreements, influence from the European Union, power structures in large corporations, national crises etc. The demonstrational quality of a project depends on the chronological and conditional connection between the first three factors mentioned. A successful demonstration must be secured so that the innovation has sufficient qualities and so that it is commercially marketable. Hal further noticed that when the innovation had other advantages such as lower costs and comfort

together with flexibility and ability to adapt to new situations, the acceptance among adopters was wider. The influence of these factors for adoption has earlier been stated by Kruijssen (1999 in Hal 2000 p. 43). The success of a demonstration project is further determined by the project organisation, for example the involvement of a product or process 'champion' (see section 2.5), and the involvement of someone with an influence on their colleagues, an 'opinion manager'. Concerning the information transfer, Hal concludes that if the involved actors are willing to share their experiences, the innovation is more likely to be received positively. Hal (2000) states that the adopter wants to see previous examples with proven success which have been evaluated over a longer time. The fourth factor in Hal's model, governmental policy, concerns the long-tem perspective that only the government can have with influence on regulations, subsidies etc.

Time lags and threshold for diffusion

Örneblad (1997) studied a building experiment in Järnbrott, Göteborg where air-solar collectors were applied to a refurbished flat block from the 1950s along with a greenhouse for the tenants[54] (Picture 4.5). An earlier technical evaluation of this 'solar multi-family block' showed a 40% reduction in bought energy in comparison to a reference house (Gustén, 1992 cited in Örneblad, 1997). Örneblad through her study has put into evidence the major contribution of the green house for the good social environment after the refurbishment. The relevance of the social gain and pedagogical values of the greenhouse as paths for sustainable development was not included in the technical evaluation.

[54] The green house is not part of the solar heat system. Photo by Sten Gromark

Picture 4.5 The solar house in Järnbrott in Göteborg, Sweden.

Despite good results, the Järnbrott project did not get a follow-up until ten years after it was built. At the moment, the architect and innovator of the air-solar collector in Järnbrott has initiated a new demonstration project (with support from the European Union programme SHINE) using solar energy, and with the complement of a green house (not part of the energy system), in a refurbishment in Gårdsten a residential area from the 1970s in Göteborg (see Chapter 8). Örneblad explains the delayed follow-up as a lack of public instruments that favour environmental initiatives, and as a result of the sceptical attitude in the building sector towards buildings with environmental ambitions (Örneblad, 1997 p. 54, compare with results from Hal above). Further, it can be explained by a reorganisation of the public housing company, the client for the project, resulting in a loss in interest in the Järnbrott experiment. Another explanation given by the architect and initiator himself is that the positive results from Jörnbrott were presented too early when the market was not yet ready (Nordström, 1990). Such *time lags* are often observed in the introduction of new technologies (Hughes, 1987 qouted in Kain 2000; Koomey and Sanstad, 1994). It takes time for new technologies to be accepted and used, for example due to the time and effort needed for practitioners to learn about the new technique (cf. Rudberg and Winquist, 1990). As described by Hughes (1987 qouted in Kain 2000) change in large socio-technical systems can be inhibited by existing stabilized networks (see also section 3.7).

The special character of the demonstration project

Ericson and Johansson (1994) have in their study of ideas and knowledge in the Swedish housing construction sector distinguished three types of housing production projects: ordinary projects, city condensation, i.e. rising of development density, and *special projects*. Within each of these types of projects there is according to Ericson and Johansson a certain and predetermined way of communicating among involved actors that will decide the structure of their meeting. The building experiment, the demonstration project and the sustainable building project belong to the third category of *special projects*. According to Ericson and Johansson these projects distinguish from the rest as they have a basic idea or image as supporting component in the project. As a result some resources will be given a larger value than in the other kinds of projects. For example, the co-operation between actors is different in an experiment or demonstration project and the engagement to fulfil the special objectives larger. The actors have, tough they might have different objectives for their engagement in this special project, joined in the common task to carry through the project (cf. Kadefors, 1992; Lundin and Söderholm, 1994).

Ericson and Johansson (1994 p. 316) point out that the idea of how these special projects can contribute to the knowledge build-up in the building sector in general has to be changed. An innovation or concept cannot unbiased be taken from a special project and be incorporated in an ordinary project where the conditions for new ideas and technologies do not fit into the normal routines. In the ordinary project there are usually less resources, engagement or time to deviate from the ordinary routines.

Granath (1991 p. 26) points out that results achieved in projects having the character of a ‘research event’ cannot be counted on to succeed or survive in the real world. Granath refers to similar results by a Norwegian sociologist in Norway in the 1960s. Experiences from Denmark show a risk that demonstration projects with insufficient local involvement become ‘installations’ created by outside experts and researchers without local connection (Jensen, 1996). Accordingly, the processes initiated by the experts or researchers have difficulties to continue after the time-limited project has been completed.

4.9 Summing up

In this chapter the definition of the terms building experiment and demonstration project have been derived from an etymological explanation as well as from their application. Moreover, experiences from earlier studies of building experiments and demonstration projects have been presented. These experiences point out the importance of building experiments and demonstration projects for the continued development of building practices but they also indicate necessary changes for an enhanced effect of such investments.

According to the literature, the building experiment and the demonstration projects belong to a chain of research and development from new ideas or innovations through one or several experiments to a demonstration project and then final diffusion to mainstream building. The chain should not be understood as strictly linear as more often driven by practice than by research (Rudberg and Winquist, 1990). The demonstration is the last step before the diffusion into mainstream building practices and some authors find this step to be a necessary phase (Buijs and Silvester, 1996). It is important to distinguish the experiment from the demonstration to avoid that technique or concepts are introduced too early, which in the case of failure can lead to negative demonstrations.

The etymological derivation of the term experiment is to try a hypothesis while the term demonstration means to exhibit and show. In the literature no large difference is made between the full-scale building experiment and the full-scale demonstration project. They should both prove and proof though there is usually larger risk involved in an experiment than in a demonstration project. In both kinds of projects focus should be on clear objectives, evaluation and dissemination of results. The experiment is by one author seen to have higher ambition than the demonstration project (Gromark, 1992). Whereas some authors point to the demonstrational values in building experiments, the experimental part of demonstration projects is absent.

The majority of the referred studies point out deficiencies in documentation, evaluation and dissemination of results from demonstration projects. The double function of the building experiment and demonstration project in commercialisation of innovations at the same time as contributing to knowledge build-up often implies that one

of the functions is neglected. The lack of evaluations and dissemination of results, and a badly functioning or non-existing change agency, have both in Sweden and in the Netherlands resulted in successful results not being implemented. In the Netherlands this has even lead to repeated mistakes (Silvester 1996 in Hal van, 2000).

However, shortcomings in evaluation and dissemination of results and experiences are not the only factors that will venture the reproduction of successful results from experiments and demonstration projects. As pointed out by Hal (2000) the quality of the innovation and the organisation of the demonstration project will influence the diffusion of results. Other factors that will have an influence are economical conditions, risk, governmental policies etc. (compare with section 3.7, factors that set the conditions for changes in the building sector in general). Furthermore, the introduction of new technologies is often delayed by time lags.

Finally, Ericson and Johansson (1994), with support by other authors, state that special conditions connected to building experiment or demonstration project will imply that the results cannot unduly be transferred to an ordinary project where not the same conditions are found. This refers to conditions such as engagement of involved actors, and time and finances for the project. Lundin and Söderholm (1994, see section 3.2) argue that the very fact that the organisation in a building project in general is temporary can be a prerequisite for the acceptance of conflicting interest in the team in order to carry out the main task the building project. Granath (1991), indicates that the label ‘experiment’ or ‘demonstration’ can in itself be a hindrance for the application of results as this refers to an ‘research event’ and special conditions.

Chapter 5 Methodology and Approach

This chapter presents the overall research approach, the research design and the methods used in this thesis. The thesis can be described as explorative, making use of qualitative research methods. An introduction is given to discourse analysis, which has been an inspiration for the discussion of findings in the empirical material. Furthermore, the chapter presents the empirical material consisting of four separate studies and the different methods used for data collection and analysis. These four empirical studies provide a complementary perspective in the understanding and exploration of demonstration projects for sustainable building.

5.1 Research approach

The approach to the research area has been *explorative*, aiming at an *understanding* of a certain problem or phenomenon i.e. demonstration projects for sustainable building. The methods used are *qualitative*, and the research process can be described as *abduction*.

In general, two types of 'ideal' research approaches can be distinguished: deduction and induction (Alvesson and Sköldberg, 1994, p. 42). Deduction starts from theory and searches evidence for, or falsification of, a hypothesis through the empirical material. This could be called the 'way of justification' (Starrin et al., 1991, p. 14). Induction, on the other hand, has its point of departure in the empirical material, and from this creates theory through a 'way of discovery' (ibid). Glaser and Strauss (1967) have thoroughly described an inductive method in formulating their 'grounded theory'.

Abduction is basically found in between deduction an induction, even if more towards induction than deduction (Alvesson and Sköldberg, 1994). Abduction as induction is based on empirical observations, but

does not reject a theoretical pre-understanding of the field, thus approaching deduction. In abduction, the analysis of the empirical material can be combined with earlier theory as a source of inspiration. Abduction can be characterized as an *iterative* process between collection and analysis of empirical material and the study of theory in literature (Starrin, 1994). As described in the inductive 'grounded theory' the researcher should not have any fixed ideas or theories in mind (Glaser and Strauss, 1967). This is also valid for the adductive approach in this thesis. Even so, the research question cannot be approached without some pre-knowledge in the field (Glaser and Strauss, 1967). There should be a balance between pre-knowledge about the field and openness of mind.

Omong other things, my personal experience of the research field 'demonstration projects for sustainable building' is based on three earlier studies of demonstration projects for sustainable building. The first of these studies, published as a guidebook, presented a number of examples of sustainable buildings, mainly private houses and schools, in the western parts of Sweden (Femenías, 1994). The second study gave a description of, and the background to, the emerging 'eco-municipality' of Bergsjön in Göteborg in the late 1990s (Femenías, 1998). The third study, also a guidebook, presented a larger number of national demonstration projects and private initiatives for attaining sustainable building in the Netherlands together with a description of the Dutch political investments for supporting sustainable building in the 1990s (Femenías, 1999a). Through these earlier studies of demonstration projects for sustainable building my pre-understanding of the research field have been formed. My point of departure has thus been directed by the experiences from these earlier studies (see discussion in Hartman, 1998 p. 136). For example, the questions of how to study, evaluate and present demonstration projects for sustainable building in order to provide useful information for actors in the building sector has emerged from these earlier studies.

5.2 The research design and the empirical studies

The empirical material for this thesis has been collected through four separate studies in which demonstration projects for sustainable building

have been studied from different perspectives. The first study consists of two case studies of demonstration projects for sustainable building, one in Sweden and one in the Netherlands. The second study is an interview study with actors in the Swedish and the Dutch building sectors. The third study is a study of the image and information of demonstration projects for sustainable building conveyed in the Swedish trade press. Finally, the fourth study is a study of how sustainable building and demonstration projects have been presented and debated in *Arkitektur, The Swedish Architectural Review*.

For the first two studies, material was collected in both Sweden and the Netherlands. The third and fourth studies, of the trade press and the one presented in *Arkitektur*, were only carried out in the Swedish context. Together, these four studies give an enriched empirical basis for a discussion about demonstration projects for sustainable building. Moreover, the use of multiple sources and methodologies improves the validity of the findings.

The research process can be described as an iterative process between the empirical material and literature studies. The problem space was initially *expanded* in order to capture the larger picture of the research field, and then successively narrowed down in order to establish the research objectives. Such successive delimitation of a problem space, according to Newell and Simon (1972 cited in Lundequist, 1995a), is central in all problem solving.

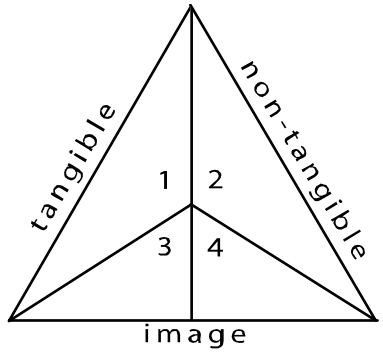
Basically, findings from the first explorative study of demonstration projects have been guiding for the design of the remaining research. Findings from this first study include a model for presenting and understanding the influence of demonstration projects for sustainable building. This consists of three dimensions: 1) the *tangible*, the visible features; 2) the *non-tangible*, features hidden in systems and in the realisation process; and 3) the *image* spread by the projects landlords themselves and the media. These three parts provide complementary information for a comprehensive understanding of demonstration projects for sustainable building.

A model based on these three perspectives described above was used for the research design (Figure 5.1). The first study, the case studies, includes all three dimensions even though the tangible or physical, i.e. the built environment and the buildings, have a central role. The

conclusion after the first study was that more cases studies of this kind would not add to the understanding of the influence on and relevance of demonstration projects for sustainable building with regard to mainstream building development. Instead, studies focusing on other dimensions of demonstration projects, as described in the model above, were found as being more relevant. This refers to the role of the actors and the every-day practice in the building sector (the non-tangible dimension) and the role of the trade press as information carrier (the image dimension). A second study, an interview study, was designed with the aim of acquiring a better understanding of the non-tangible parts of a demonstration project. This study focuses on the actors involved in demonstration projects including the respondents' knowledge base, approach to sustainable building and frames of reference. Whereas the tangible dimension in the three-legged model refers to knowledge that is easily reached and externalised, the non-tangible dimension refers to knowledge that is seldom externalised or difficult to externalise (see discussion in section 3.4).

The third perspective, the image, has been approached through two studies focusing on the image of demonstration projects and sustainable building conveyed through the Swedish trade press. These studies were deemed to be motivated as the first and the second studies indicted that the trade press form one important source of information about demonstration projects for sustainable building for actors in the building sector. The third study takes in a wider scope of the Swedish trade press in general[55], while the fourth study focuses exclusively on the architectural press through a study of the Swedish architectural periodical, *Arkitektur*.

[55] This study was carried out in co-operation with Pernilla Gluch, doctoral student at the Department of Building Economy and Management at Chalmers University of Technology, and part of the former MISTRA Sustainable Building Programme.



1. case studies (Sweden/The Netherlands)
2. interview study (Sweden/The Netherlands)
3. study of the Swedish trade press
4. study of the Swedish review *Arkitektur*

Figure 5.1 The empirical material: Four separate studies based on different empirical material and using different methods for data collection.

The empirical material is rich in detail and is extensively presented in this thesis. This is motivated by the value of such descriptions in themselves. Accordingly, , on the one hand, the empirical material has the purpose of providing valuable descriptions of the world of practice, and how this world of practice handles the issue of sustainable building. On the other hand, the empirical material has been a means of exploring the research field and to find themes for discussion, future research and practical implications. A third purpose for the empirical material is explanatory. The empirical material has been the basis for an attempt to explain why the world of practice acts and works as it does (compare with Yin 1994, p. 10 explanation building). This 'explanation building' addresses large questions for research and practice concerning sustainable building. It is outlined in this thesis, and opens up for continued discussions and research in the field.

5.3 A discourse perspective

Sustainable building as a research field within the architectural domain is relatively new and there do not exist any clearly defined frames of reference. The theoretical basis in this thesis has been chosen from different theoretical fields in order to provide a useful framework for understanding and explaining the findings in the empirical material.

Theoretical approaches have been chosen from: design theory, organisational theory, and innovation theory (see Chapter 3). Moreover, the approach has been inspired by discourse analysis. The interest in discourse analysis can be explained by the thesis approaching the question of the (social) construction of knowledge and the understanding of demonstration projects for sustainable building among actors in the building sector, through practice, and through the information in national strategies and in the trade press etc. Even though the specific methods for discourse analysis have not explicitly been used, discourse analysis has inspired the interpretation of findings in the empirical material.

Discourse analysis

There does not exist any clear definition of the concepts of *discourse* and *discourse analysis*. The following presentation is mainly based on Winther Jørgensen and Philips (2000)[56]. The term discourse usually involves ideas of how language is structured in different patterns that we follow when acting within different social domains (Winther Jørgensen and Philips, 2000). One can say that a discourse is a certain way of talking about and understanding reality (or a part of reality). Discourse analysis, according to Burr (1995 cited in Winther Jørgensen and Philips, 2000 p 11), is based upon a social constructionist[57] view implying the acceptance of four premises: 1) a critical view upon objective knowledge; 2) an acknowledgement of the dependence on history (previous events) as well as the specific in all social situations; 3) the underlining of the relation between knowledge and social processes; and 4) the underlining of the relation between knowledge and social actions.

A usual contemporary apprehension is that there does not exist any ruling ideology or discourse in contemporary society, but different discourses (Winther Jørgensen and Philips, 2000 p. 23). Consequently, there are different possible positions for the actor (subject) to speak and act from. Different discourses can also be seen as struggling to dominate the discursive arena. A discourse will be established through the

[56] The work by Michael Foucault is an important basis in discourse analysis, but his work is not referred to in this thesis.
[57] Winther Jørgensen and Philips use the term social constructionist instead of social constructivist in order not to confuse with the constructivist theory of Piagets.

definition of central concepts, but also through *exclusion* of other interpretations. The users/actor can take elements from different mass-medial and interpersonal communications in the creation of hybrid discourses. In this production of such new discourses the individuals will become actors in a discursive and cultural change.

According to Winther Jørgensen and Philips (2000 p. 23), discourse can either been seen as completely *constituting reality*, or *constituted by reality*. Consequently, discourse can be seen as not only reflecting but also constructing reality (constituting), or to be a mechanical reproduction of other social practices (constituted). The former does not separate discursive practices from non-discursive practices. All practices (also material such as infrastructure, institutions and economy) are seen as discursive. The latter does not in reality belong to discourse analysis, as for example historical materialism does not recognise the influence of discourse on other forms of social practices.

The critical discourse analysis of Fairclough

Discourse can be seen as *one of several aspects* that create the social world. This view, based upon the critical discourse analysis of Fairclough (Fairclough 1992; Fairclough 1993; Winther Jørgensen and Philips, 2000), is relevant for this thesis where different kinds of theory, and not exclusively discourse analysis, are used to explain features found in the empirical material. The critical discourse analysis recognizes dialectic interplay between different social practices. The discourse does not only contribute in forming and transforming social structures and processes, but also reflects them. The critical discourse analysis is critical in that sense that it has as a task of elucidating the role of the discursive practices in the social world. The focus is *both* on the discursive practices that constitute our world-views, social relations etc, *and* on the role these discursive constructions have in supporting certain social groups' interests. The discourse in the critical discourse theory is both constituting and constituted. The discourse contributes in constituting: social identities, social relations, as well as knowledge and value systems.

With social structures, Fairclough means social relations in society that have both discursive and non-discursive elements (Winther Jørgensen and Philips, 2000 p. 71). Practices like construction are seen

as primarily non-discursive. The discursive practices do not only reproduce an already existing discursive structure, but question the structure by pointing out that which is outside the structure.

The methodologies proposed by Fairclough include both textual analysis and the analysis of social practices where everyday social relations are based on a set of 'common-sense' rules and procedures (see practice and praxis section 3.4). Fairclough does not consider textual analysis sufficient, as this does not focus on the interrelation between the texts and the social and cultural processes. Instead, an interdisciplinary perspective is needed combining textual and social analysis. Fairclough (1992; 1993) uses a three-dimensional model for discourse analysis distinguishing: the text (speech, texts, pictures or a mixture of the textual and visual); the discursive practices, including production and consumption of texts; and the social practices.

5.4 Methodology used in study 1: The case studies

The case study methodology used in study 1 is mainly built on Yin (1994). Case study methodology is an often-used method in architectural research (Linn et al. 1998/2000 p. 101 – 102). An architectural project is complex and contextual and best understood through the study of concrete cases (compare with section 3.4). As described by Yin (1994), case study methodology can be used when a contemporary phenomenon should be investigated, especially when the contextual conditions are sought for. Case study methodology will be useful in reconstructing an understanding of the architectural project as a comprehensive unit.

According to Yin (1994), case study methodology is relevant when searching for the answers *how* and *why*. It approaches historical studies in that no manipulation of the observed can be done. In contrast to an experiment, in the case study the boundaries between the studied phenomenon and the context are not clearly distinguished or 'controlled' (Yin, 1994 p 13). Furthermore, Yin proposes that the researcher formulates in advance different possible outcomes of the case study. This to avoid that the case study will merely confirm assumptions formulated beforehand.

The validity of case studies increases when using multiple sources of evidence (Yin, 1994 p. 79 – 101). The use of multiple sources and

several interview respondents should prevent the case description from being based on the biased information from a few actors (see, Yin, 1994 p. 90 – 92). Actors involved in the complicated process of bringing about a building project only master one part of the problem. As described by Sahlin-Andersson (1986 p. 16):

> The phenomenon appears for the individual actor as fragmented and sectored, as each actor only takes part in and has knowledge about a part of the whole process.[58]

Another problem with interviews is that a few years after the completion of the project, the actors have a tendency to 'create a story' that will be told over and over again, and thus confirmed (Sahlin-Andersson, 1989).

Westlander (1992) argues that case study methodology originally has the implicit signification that only one specific, unique or deviating case is studied. Yin (1994) claims the value of multi-case studies or cross-site analysis in comparisons involving several cases. The case study carried out in this thesis is built on two different cases. They are carried out and analysed separately, but not independently, and findings from both cases are brought together in a joint discussion.

The cases

The cases are two demonstration projects for housing planned and built in the 1990s. The first case is a Dutch demonstration project, the GWL–terrain, with over 600 dwellings in the central parts of Amsterdam. The project includes the car-free urban plan for the area, as well as 17 housing blocks and a few offices, shops and other premises. The project was one of the first of its kind and has attracted considerable attention in the Netherlands as well as abroad. The second case is found at Lindholmen, Göteborg in Sweden. It is a housing block with 13 flats in a district of listed 19th Century buildings.

The choice of cases was motivated by several factors (see further section 1.2). Firstly, these projects are intended to be demonstration projects and not experiments. Secondly, they are built in an urban

[58] "Företeelsen framstår för den enskilde aktören som fragmentiserad och sektoriserad, då varje aktör deltar I och har kännedom om endast en del av hela processen". (Sahlin-Andersson, 1986 p. 17).

environment and provide housing for the 'normal' user, who is perhaps not willing to radically change his or her behaviour. Thirdly, both project have architectural ambitions and have involved prominent architects that also function as opinion-leaders among architects. Altogether these factors indicate potential broad interest in the results and applicability of the demonstration project.

The cases have been studied regarding both product and process in order to reach a comprehensive understanding. This will be necessary when searching for applicable and reproducible concepts and techniques from the demonstration projects. Birgersson (1996) argues that in order to distinguish that which is generally applicable in a case, in this study the demonstration project, from that which is specific, both product and process must be studied simultaneously. Problems can arrive when a specific solution observed in one case or demonstration project is applied to another project, or to another process, where the conditions are not the same. Sahlin-Andersson (1989 p. 62) argues that the process in a building project loses its logic if the time and place is excluded. According to Sahlin-Andersson, it is important to know exactly what the model in the example is: whether it is the product or the process.

Data collection

The case studies are based on multiple sources: documents and proceedings from the process, drawings and early sketches, brochures and information from the client, interviews with actors (mainly key actors - but also a few peripheral actors and residents), as well as newspaper articles and trade press articles[59]. Furthermore, the cases have been visited and photographed on several occasions. Data was collected for the Dutch GWL—case from 1998 – 1999. Interviews with the actors were carried out in the summer of 1998. In all a total of 16 actors and persons living in the area have been interviewed. In addition, other studies carried out by GWL—terrain was used (W/E Adviseurs, 1995, Boels, 1997, Hal, 2000), as well as an evaluation (Nieman adviesburo, 1999). Quotations from articles and brochures have been translated from Dutch to English by Barbara Motel.

[59] Sources for the case studies as well as all persons interviewed are listed in the references.

Data for the Swedish Lindholmen-case was collected in the summer of 1998 and complemented in February 2000, parallel to the collection of data for the GWL—case. Only a few documents and minutes could be collected from the process in the Lindholmen-case. Here seven interviews were carried out with: key actors, persons living in the area and the local administrator.

Interviews in both cases were conducted with the aid of an interview guide[60], and the interview methodology was identical to the one for study 2 (presented in section 5.5). However, the interviews were not recorded. Instead notes were taken and the interviews were typed out immediately after. The interviews lasted about 1 – 2 hours and the interviews in the Netherlands were carried out in English. The transcribed interviews were sent back to the respondents for approval and correction. Furthermore, two independent key actors have read and corrected the case description of the GWL—case before being published[61].

Analysis

Data for the GWL—case has been analysed at two levels. Firstly, a description and structuring of the vast material was carried out. Such a description in itself provides an understanding about the case (Sahlin-Andersson, 1986; Falkheden, 1999). Secondly, an evaluation was made using methods from evaluation research. For the Lindholmen case, only the first part of the analysis has been carried out. It was not found necessary to carry out the same long procedure for the second case in order to arrive at applicable findings.

In the description data has been sorted, and that not found to be relevant to this particular study has been left out. What material was selected, and the way in which this material was presented, is important for understanding the case and will have an influence on the following evaluation and results. Accordingly, the structuring was carried out to put the specific research questions into focus.

[60] An example of an interview guide is found in appendix A. The guides were not identical but adapted for the actor to be interviewed.
[61] The original description was presented in the licentiate thesis (Femenías, 2000a), and has been reorganised and shortened in Chapter 6.

The deeper analysis of the GWL—terrain was carried out using methods from evaluation research (Nilstun, 1980, 1988; Nydén, 1992). According to Nilstun (1980, p. 15), an evaluation should explain why a specific measure gave a certain result. Nilstun identifies six partial analyses and six questions that should be considered (Nilstun, 1980 p. 15):

1. Analysis of the program in question
2. Analysis of the effort: What efforts were made to reach the goals?
3. Analysis of the effect: What was the result of the efforts?
4. Analysis of the process: Why the efforts gave this result.
5. Analysis of the fulfilment of goals: How does the result relate to the goals?
6. Analysis of efficiency: Were the efforts an efficient way to reach the goals?

These partial analyses do not have to be considered in this order, or even to be specified like this. The important thing is that the evaluation contains these questions. When making an evaluation the first and most important question is: What is the focus for the evaluation? What type of knowledge should the evaluation provide? Why should the evaluation take place?

An evaluation matrix found in Nydén (1992), originally designated for evaluations of research and development programmes was found useful and was altered to suit the purpose of evaluating the case studies. The matrix separates product and process related issues and indicates 14 **issues** that were posed in the material. Table 5.2, shows the structure of the evaluation guide used for the GWL—case.

Table 5.2 The evaluation matrix used for the GWL—terrain case based on Nydén (1992). For further explanation of each field in the matrix see Femenías 2000a).

	Product	**Process**
Relevance of ambitions and goals	Regarding sustainability goals in the country.	Regarding learning processes in sustainability issues.
Efforts	Environmental programs, advisors, etc.	Problem solving and ways to achieve goals.
Prerequisites	Site, infrastructure, etc.	Organisation, motivation, etc.
Result	Environmental impact, "green" lifestyle, etc.	The *internal* influence of the project, among actors involved.
Fulfilment of goals	According to the environmental program.	Regarding initial intentions.
Hindrances	To implement environmental issues.	Hindrances for a good process.
Effect	The importance as a demonstration project.	The *external* influence of the project – knowledge spread.

The outcome of the project regarding knowledge build-up has been of special interest. This is referred to in the evaluation as the internal influence among the actors involved and the external influence on the rest of the building sector, decision-makers and the public.

5.5 Methodology used in study 2: The interview study

In the second study interviews have been carried out with 27 actors in the building sector, 14 in Sweden and 13 in the Netherlands. The actors were chosen among clients/developers, architects and environmental consultants. The scope is wider here than in the first study as it includes respondents that have been involved in a large range of demonstration projects in both countries. These respondents have been selected with regard to their position of having an active influence on the practice and discourse concerning sustainable building in their respective countries. They were selected with the help from authorities within the field of sustainable building in both countries[62]. The selection can be seen as

[62] Help to select the respondents was provided by Professor Micheal Edén and Professor Björn Malbert at Chalmers University of Technology as well as Dr Anke van Hal and Architect Tjerk Reijinga in the Netherlands.

strategic and qualitative in order to obtain the desired information[63] (see for example Falkheden, 1999, p.262 – 270).

The interviews were carried out from June 2001 to February 2002. The interviews are *half-structured qualitative interviews* carried out with a supporting thematic guide[64] (Kvale, 1997). The interview guide has not been strictly followed, and has been developed during the course of the study. Initially two *pilot interviews* were carried out (see for example Yin, 1994, p. 75) in order to develop the interview guide and try out the methodology. The interviews could also be characterized as *open-ended* and *focused* (Yin, 1994, p. 84). The respondents' opinions in matters have been asked for with a point of departure from a prefixed set of themes. The respondents have been able to decide upon the length and focus of their answers. There has also been free scope in the interviews for themes taken up by the respondents. Kvale emphasizes that the qualitative research interview is a social interaction, a dialogue and interchange between two persons about a common area of interest (Kvale, 1997 p. 9). The qualitative interview is characterized by discovery and is primarily searching for an understanding.

The interviews averaged 1 hour to 1 and ½ hours in length. In general, the Swedish respondents have had more time, and for this reason the Swedish interviews have been longer and more consistent than the Dutch ones. Interviews in the Netherlands have been carried out in English. Deficiency in the English language among the respondents has occasionally resulted in reduced information. Quotations from the Swedish interviews presented in Chapter 7, have been freely translated by Marie Carlsson.

All the interviews have then been transcribed word-by-word resulting in a total of about 680 pages[65]. Interviews as empirical material have various weaknesses (Yin, 1994, p. 80): bias due to poorly constructed questions; response bias- inaccuracies due to poor reflexivity – the interviewee gives what the interviewer wants to hear. In order to increase the validity of the interview study, the interviews have been sent back to the respondents for commentaries. Before the publications of the findings, the respondents have had the opportunity of giving their reactions to the material.

[63] A larger number of respondents would have made the study to difficult to handle.
[64] An example of this interview guide is found in Appendix B.

The analysis has been carried out manually departing mainly from the already defined themes in the interview guide. This could be referred to as what Glaser and Strauss (1967) call selective coding compared with open coding that is not based on prefixed themes[66]. Furthermore, the analysis has been carried out in two phases. A preliminary and limited analysis was carried out in spring 2002[67]. A continued and deeper analysis was then carried out in autumn 2003[68].

5.6 Methodolgy used in the study of trade press (study 3 and 4)

The third study focuses on the image and information conveyed from three Swedish demonstration projects for sustainable building in the Swedish trade press. The fourth study, on the one hand, has a somewhat narrower scope than study 3, and focuses solely on articles in *Arkitektur*, a Swedish architectural periodical. On the other hand, study 4 is broader in the respect that all the articles focusing on sustainable building during the period 1973 – 2002 have been included.

The studies are mainly analyses of the content of texts, even if also illustrations, pictures etc. have been taken into consideration. Fairclough (1992) argues that one cannot properly analyse content in a text without simultaneously analysing form. The study aims at discussing the value of the content in the articles studied for a presupposed audience of actors in the building sector. However, in this study, the text itself is in focus, and not the producing or the receiving contexts (cf. Bell and Garett, 1998).

The method used has mainly been inspired by earlier studies making use of text analysis by Djerf-Pierre (1996) and Thompson (2001). The methodology has been developed and applied by Gluch and Femenías (2002a, 2002b) in study 3 of the trade press, and applied in study 4 on *Arkitektur*. Mainly qualitative content analysis has been used involving

[65] 420 pages Swedish interviews, and 264 pages Dutch interviews were transcribed.
[66] According to Glaser and Strauss (1967), open coding should be followed by selective coding once the main variables are detected. In this study, what could be called main variables were already decided upon.
[67] Findings from this preliminary analysis were presented at the Sustainable Building Conference in Oslo September 2002 (Femenías, 2002a).
[68] The analysis was delayed due to for the fact that I took parental leave for one year followed by a doctoral exchange with an Institution in France during spring 2003.

features from quantitative text analysis. For the qualitative analysis, the text must be analysed according to a systematic procedure like in quantitative analysis, but with the difference that the categories are iteratively tested and revised as they emerge (Djerf-Pierre, 1996; Thompson, 2001). The qualitative analysis is in this case also a result of the researchers pre-knowledge about the field of architecture and sustainable building. The result from a qualitative content analysis can be said to be an inclusive representation of patterns found in a body of articles, the corpus (Thompson, 2001). A theme or pattern is a significant idea appearing in the core corpus of articles considered as a whole.

5.7 Validity and reliability

Validity and reliability are two central concepts for the applicability of the findings from research. The validity of the findings in this thesis is strengthened as four separate studies have been carried out, and that the findings are confirmed by results from one study pointing to similar issues or supporting results from the other studies. The validity is further strengthened as similar results and problem identifications have been made in other studies in the field (see Chapter 4). This can be referred to as external validity (Yin, 1994), and should imply a generalisation of results.

The validity also relies on several types of triangulation (see Patton 1987 referred to in Yin, 1994, p. 92; Larsson, 1994). First of all, several kinds of data sources, referred to as *data triangulation*, have been used as well as several methodologies, (*methodological triangulations*: case studies, interviews, and textual analysis) to approach the problem field through different studies. The case studies alone also use multiple sources of evidence and methods, including interviews, studies of documents from the process and plans/drawings, studies of the built environment, and studies of brochures and journal articles. In discussing the material using several different theoretical approaches, the thesis thus further uses *theoretical triangulation*.

In the case of the study of the Swedish trade press, the validity of the findings has been improved through the joint analysis of two doctoral

students with different scientific backgrounds[69]. This is referred to as *investigator triangulation* (Patton 1987 referred to in Yin, 1994, p 92; Larsson, 1994). The analysis was partly carried out individually with the individual results later being compared, and partly the analysis was carried out in a group discussion.

Furthermore, the validity of the case studies has been improved as an outline of the case study and transcripts of the interviews were sent to the actors and respondents involved for approval and correction. The same procedure was used in the interview study were transcripts of the interviews and later an outline of the analysis were sent to the respondents[70].

The reliability of the findings is supported by what Yin calls a case study database, which is the collection of all the empirical data used and a description of how the study was done (chain of evidence) (Yin, 1994, p. 94 – 99). In this way it is possible for the reader to follow the derivation from description to conclusions, and if necessary return to the empirical material. However, as is the case of a qualitative study it can be difficult or even impossible to repeat the studies identically.

5.8 Summing up

This chapter has presented the methodological and research approach, the research design as well as the specific methods used in the four empirical studies. The research approach is explorative and qualitative and the process can be described as an iterative process between the collection and analysis of empirical material and studies of theory in literature.

The empirical material consists of four separate studies based on different content. Together, these four studies provide different perspectives on demonstration projects for sustainable building, and thus an enriched empirical basis for a discussion. The use of multiple sources and methodologies furthermore improves the validity of the findings. A three-dimensional model recognizing the tangible, the non-tangible and

[69] PhD student Pernilla Gluch has a background as engineer and is currently a doctoral student at the Department of Building Economics and Management at Chalmers University of Technology.
[70] Even though sent to all the respondents, only a few of these reacted and sent commentaries and corrections.

the image dimensions of demonstration projects has been used for designing the four empirical studies. The empirical material provides themes for further discussion and a basis for the understanding of demonstration projects. In addition, the empirical material has a value in itself in providing concrete descriptions of real-world situations.

The first study, two case studies of demonstration projects for sustainable building, based on case study methodology by Yin (1994) mainly belong to the tangible part of the demonstration project model. The data used for the case studies are interviews, studies of documents from the process, studies of the buildings as well as studies of articles and brochures about the projects. The analysis has been inspired by evaluation research. The second study, an interviews study with actors in the Swedish and the Dutch building sectors, aims at an understanding of the non-tangible part of demonstration projects. The method used for data collection is qualitative half-structured interviews with a thematic guide. The third and fourth studies focus on the image part of demonstration projects and study how the Swedish trade press has portrayed demonstration projects and sustainable building. The main method used is text analysis.

Besides relevant theoretical approaches chosen from design theory, organisational theory, and innovation theory in position of providing useful frameworks for understanding and explaining the empirical material, discourse analysis has been found useful in the understanding of the different interpretations and approaches to sustainable building found in the empirical studies and in the literature. Even though the specific methods for discourse analysis have not been used; the discourse theory has inspired the frame of reference for interpretation. Thus the discourse analysis is seen as one of several aspects that create an understanding of the empirical material. The discourse is seen as both constituting and as constituted by: social identities, relations, and knowledge and value systems.

The validity and reliability of the findings is supported by data triangulation, the use of multiple sources through different empirical studies. It is further improved as findings from one study point to findings from the other studies and to similar findings in earlier studies of demonstration projects and in the literature. The third study uses investigator triangulation as the analysis was carried out in co-operation

with another doctoral student. In addition, several theoretical basis approaches have been used in the discussion of the findings, thus making use of theoretical triangulation.