Management and Sustainable Architecture
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Angela Maria Haug

Examination Project Work, Sustainable Design and Management, Second cycle, 15ECTS

Master of Science

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Abstract

Sustainable architecture is about meeting the environmental, cultural, social and economical needs of today without compromising the ability of future generations to fulfill their own needs. This is quite a complex and challenging task because the architect must consider the impact of these needs through the whole life cycle of the building.

The objective of this thesis is to evaluate what the management can do to support and create an environment where the architects can inspire and excel in the complex and challenging task of implementing sustainable solutions in architectural projects. Further to map prohibiting factors that architects working with sustainable architecture meet and describe the whole building chain and what factors are important to support development of sustainable architecture.

This thesis investigates in theories of environmental management, knowledge management, change management, psychological and economical aspects of environmental problems. The theories draw among some principal guidelines that the management should aspire to define a new business logic that is rooted in a wider view of human values and ethics, concerning time, quality, cost reduction, distribution and critical staffing issues. Encourage employees to respond emotionally to an issue is a natural and powerful motivation for action. They see, then feel and then change behavior. Encourage employees to spend time in the nature to experience that we are interconnected with the nature and that we are dependent on it. This perspective leads to sustainable behavior that is not based on self-sacrifice or self-denial, but out of a sense of love and common identity.

The architectural organizations interviewed describes quite similar aspects but highlights the importance of letting environmental issues be equally important and incorporated with other significant issues, learning by doing and letting the process be flexible, take its time and give room for communication in order to develop naturally. When working with complex sustainable solutions it is important to avoid pre-accepted solutions by understanding the whole picture and thinking on your own. They experience how valuable it is to use successful environmental architecture as inspiration and how counterproductive “bad” environmental architecture is to sustainable development. The management must focus on removing prohibiting factors to relieve and protect the architects from these strains so that they can preserve and use their energy on sustainable development instead. Initiating projects with a broad approach, establishing a broad and qualified network and cooperating and communicating across the whole building chain in the initial stages of the project, supports better and holistic solutions and decrease the costs and time frame of the project. Overall one of the most important factors is to encouraging a feeling of community in the organization. It is central because it provides a work environment where the employees inspire, share knowledge and support each other to strive for good results. Such a work environment equips the organization to be better at facing rapidly changing and complex demands.
Preface

This degree project in Sustainable Design and Management was inspired by a wish to explore the area of architecture and environmental issues. During the participation in a project with the environmental group at an architectural firm in Oslo for five months many interesting aspects was discussed when deciding the topic for this degree project. However the most interesting and predominant issue was to investigate how the firm can better integrate environmental issues in their projects, by mapping what factors work for and against integrating environmental issues in architectural projects and give suggestions for how the management can support and improve this process at the firm.

During the work of the degree project three architectural firms was interviewed, they were all enthusiastic regarding the topic and many interesting aspects was brought up.

I want to emphasize my appreciation of the possibility to work together with the architects and their willingness to give time and share valuable thoughts. I am especially thankful for the professional and personal support from my supervisor Stina Alriksson.

Angela Maria Haug

Oslo, June 2010
There is a need to shift our focus, onto sustainable development in order to improve the global environmental, economical and social situation. The organizations are a major driving force to do this and they can be a role model for creating a sustainable future. The built environment affects all three areas and the construction sector has the potential to impact in a more positive and long term aspect. Within the construction sector the architect is one of the key players to inspire and implement sustainable solutions from the initial stages of the projects.

Sustainable architecture is about meeting the environmental, cultural, social and economical needs of today without compromising the ability of future generations to fulfill their own needs. This is quite a complex and challenging task because the architect must consider the impact of these needs through the whole life cycle of the building. It implies among some missions designing for easy reuse, recycling and remodeling of the building and building material, collection and purifying of water, use sunshine, wind, water and earth to regulate indoor climate and generate electricity, support a balanced ecosystem, educate and inspire for increased sustainable awareness and promote the health and well-being of occupants and neighbors. There are many good solutions that are found in nature and it is valuable to let nature inspire and teach how we can solve these missions. Good architectural quality increases its value and thus its life time, because it is more likely that such a building is taken better care of by its occupants and society.

The objective of this thesis is to evaluate what the management can do in order to be successful with sustainable architecture, map prohibiting factors that architects working with sustainable architecture meet and describe the whole building chain and what factors are important so that it supports development of sustainable architecture. The results from the in-depth interviews, observation study and literature reviewed show that the management must inspire, lead and give space for the architects to be more conscious and motivated to understand and seek the opportunities that exist within sustainable architecture. This process might be looked upon as a process of change. Maybe it impose a need for new ways of conducting the project processes, managing new knowledge and innovations, understanding and responding on prohibiting factors, and new mindsets and behaviors.

The theories of environmental, knowledge and change management, psychology and economical aspects of environmental problems provide the following principal guidelines for how the management can be successful with this process. The management should aspire to define a new business logic that is rooted in a wider view of human values and ethics, concerning time, quality, cost reduction, distribution and critical staffing issues. The values of sustainable development should be naturally and widely incorporated into the organization’s visions, goals, action plans, programs, practices and mindsets. This is reached by transparency, dialogue and participation and continuously improving, inspiring and motivating employees to seek the highest degree of eco-efficiency. Encourage employees to respond emotionally to an issue is a natural and powerful motivation for action. They see, then feel and then change behavior. It is beneficial to establish a work environment in which people can share their best practices, increase the quality of their knowledge, and help each other solve problems. To minimize the burden on individuals it is good to developing systems that effectively capture and build intellectual capital. The management should support employees to cope with environmental issues in a more solution oriented way, by visualizing healthy ecosystems, working with small steps and big ideas, thinking circle instead of line, considering ways in which less is more, practicing conscious consumption and act on personal and political levels, especially through community participation. Encourage cooperation instead of self-defeating competitive behavior, by highlighting the feeling of group membership and to encourage employees to spend time in the nature to experience that we are interconnected with the nature and that we are dependent on it. This perspective leads to sustainable behavior that is not based on self-sacrifice or self-denial, but out of a sense of love and common identity.

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Sammendrag


Målet med denne rapporten er å vurdere hva ledelsen kan gjøre for å lykkes med bærekraftig arkitektur, kartlegge hindrende faktorer som arkitekterne møter når de jobber med bærekraftig arkitektur, beskrive hele byggekjeden og fremheve viktige faktorer som støtter utviklingen av bærekraftig arkitektur. Resultatene fra dybdeintervjuer, observationsstudie og litteratur viser at ledelsen må inspirere, lede og gi rom for arkitekterne til å bli mer bevisst og motiveret til å søke og forstå de mulighetene som finnes innenfor bærekraftig arkitektur. Denne prosessen kan ses på som en prosess for endring. Kanskje det betyr at det er et behov for nye måter å gjennomføre prosjektprosessen, håndtering av ny kunnskap og innovasjon, forstå og fjerne hindrende faktorer og generelt nye tankesett og adferd.

Teoriene innen miljø-, kunnskaps- og endringsledelse samt kunnskap om psykologiske og økonomiske aspekter ved miljoproblemer gir en rekke hovedrettningssoner for hvordan ledelsen kan lykkes med å implementere bærekraft i bedriften. Ledelsen bør strebe etter å definere en ny forretningslogikk som er forankret i et bredere syn på menneskelige verdier og etikk vedrørende tid, kvalitet, kostnadsreduksjon, distribusjon og kritiske bemanning spørsmål. Verdiene for bærekraftig utvikling skal være en naturlig del og godt innarbeidet i organisasjonsens visjoner, mål, handlingsplaner, programmer, praksis og tankesett. Dette oppnås med åpenhet, dialog, deltakelse og fokus på kontinuerlig forbedring samt å inspirere og motivere ansatte til å søke den høyeste grad av økoeffektivitet. Å oppmuntre ansatte til å involvere seg følelsesmessig i en sak er en naturlig og kraftig motivasjon for endret oppførsel og handling. Man ser, så føler, og deretter ender oppførselen. Det er gunstig å etablere et arbeidmiljø der folk kan dele sine beste metoder, øke kvaliteten på kunnskapen sin og hjelpe hverandre til å løse problemer. For å minskes belastningen på enkeltpersoner er det verdifullt å utvikle systemer som effektivt fanger og bygger opp intelligenskapital. Ledelsen kan støtte de ansatte til å håndtere miljøspermat attraktiv på en mer løsningsorientert måte, ved å visualisere sunne okosystemer, arbeide med små skritt og store ideer, tenke sirkel i stedet for linje, vurdere og motivere ansatte til å søke den høyeste grad av økoeffektivitet. Å oppmuntre ansatte til å involvere seg følelsesmessig i en sak er en naturlig og kraftig motivasjon for endret oppførsel og handling. Man ser, så føler, og deretter ender oppførselen. Det er gunstig å etablere et arbeidmiljø der folk kan dele sine beste metoder, øke kvaliteten på kunnskapen sin og hjelpe hverandre til å løse problemer. For å minske belastningen på enkeltpersoner er det verdifullt å utvikle systemer som effektivt fanger og bygger opp intelligenskapital. Ledelsen kan støtte de ansatte til å håndtere miljøspermat attraktiv på en mer løsningsorientert måte, ved å visualisere sunne okosystemer, arbeide med små skritt og store ideer, tenke sirkel i stedet for linje, vurdere hvordan ”less is more”, praktisere bevisst forbruk og handle på personlig og politisk nivå, spesielt gjennom samfunnsdeltakelse. Oppmuntre samarbeid i stedet for selvødeleggende konkurransedyktig oppførsel, ved å fremme følelsen av gruppeombygging og å oppmuntre ansatte til å tilbringe tid i naturen for å oppleve at vi er en del av naturen og at vi er avhengig av den. Disse perspektivene fører til bærekraftig atferd som ikke er basert på selvpoffret og selvkonektet, men ut fra en følelse av kjærlighet og felles identitet.

Arkitektfirmaene som ble intervjuet beskriver de samme faktorene som viktig, men fremhever betydningen av å la miljøspermat attraktiv på en mer løsningsorientert måte, ved å visualisere sunne okosystemer, arbeide med små skritt og store ideer, tenke sirkel i stedet for linje, vurdere hvordan ”less is more”, praktisere bevisst forbruk og handle på personlig og politisk nivå, spesielt gjennom samfunnsdeltakelse. Oppmuntre samarbeid i stedet for selvødeleggende konkurransedyktig oppførsel, ved å fremme følelsen av gruppeombygging og å oppmuntre ansatte til å tilbringe tid i naturen for å oppleve at vi er en del av naturen og at vi er avhengig av den. Disse perspektivene fører til bærekraftig atferd som ikke er basert på selvpoffret og selvkonektet, men ut fra en følelse av kjærlighet og felles identitet.

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IV
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BNIM</td>
<td>Berkebile Nelson Immenschuh McDowell Architects</td>
</tr>
<tr>
<td>CM</td>
<td>Change Management</td>
</tr>
<tr>
<td>CP</td>
<td>Cleaner Production</td>
</tr>
<tr>
<td>DfE</td>
<td>Design for the Environment</td>
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<tr>
<td>EA</td>
<td>Environmental Auditing</td>
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<tr>
<td>EAc</td>
<td>Environmental Accounting</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EL</td>
<td>Eco Labeling</td>
</tr>
<tr>
<td>EM</td>
<td>Environmental Management</td>
</tr>
<tr>
<td>EMAS</td>
<td>Eco-Management and Audit Scheme</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental Management Systems</td>
</tr>
<tr>
<td>EPE</td>
<td>Environmental Performance Evaluation</td>
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<tr>
<td>EPI</td>
<td>Environmental Performance Indicators</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product</td>
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<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
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<tr>
<td>INEM</td>
<td>International Network for Environmental Management</td>
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<tr>
<td>KM</td>
<td>Knowledge Management</td>
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<tr>
<td>LCA</td>
<td>Life Cycle Assessment</td>
</tr>
<tr>
<td>LCS</td>
<td>Life Cycle Screening</td>
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<tr>
<td>LCC</td>
<td>Life Cycle Costing</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
</tr>
<tr>
<td>MET</td>
<td>Material, Energy and Toxic-analysis</td>
</tr>
<tr>
<td>MIPS</td>
<td>Material Input per Service Unit</td>
</tr>
<tr>
<td>NAL</td>
<td>National Association of Norwegian Architects</td>
</tr>
<tr>
<td>PDCA</td>
<td>Plan-Do-Check-Act</td>
</tr>
<tr>
<td>RAPID</td>
<td>Research and Policy in Development</td>
</tr>
<tr>
<td>SBTool</td>
<td>Sustainable Building Tool</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strength, Weaknesses-Opportunities-Threats</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environmental Program</td>
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<tr>
<td>WRI</td>
<td>World Resource Institute</td>
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**Phrases**

<table>
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<th>Term</th>
<th>Definition</th>
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<tr>
<td>Biomimicry</td>
<td>Means being inspired by the nature when innovating problem solving solutions.</td>
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<tr>
<td>Building chain</td>
<td>Refers to the whole construction industry, from the contractor to the constructor to the demolition workers.</td>
</tr>
<tr>
<td>Built environment</td>
<td>Is the part of the environment that is constructed by human, such as roads, parks, dams, buildings, etc.</td>
</tr>
<tr>
<td>Carrying capacity</td>
<td>Refers to the maximum population that the earth can sustain.</td>
</tr>
<tr>
<td>Cradle to Cradle</td>
<td>Is a mindset to design in the same manner as nature does, where everything continues in a cycle. Such as a tree, where the fruits and leaves are not waste but nutrients.</td>
</tr>
<tr>
<td>Ecopsychology</td>
<td>Connects ecology and psychology.</td>
</tr>
<tr>
<td>Ecological footprint</td>
<td>Is a measure of human demand on the Earth's ecosystems.</td>
</tr>
<tr>
<td>Gestalt psychology</td>
<td>Is a school of thought that looked at the human mind and behavior as wholes rather than attempting to break them up into smaller parts.</td>
</tr>
<tr>
<td>Holism</td>
<td>Is the idea of that the whole is more than the sum of its parts.</td>
</tr>
<tr>
<td>Life cycle of a building</td>
<td>Refers to the whole life span of the building, from construction to demolition.</td>
</tr>
<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design is an American rating system for green buildings.</td>
</tr>
<tr>
<td>Overconsumption</td>
<td>Refers to a consumption per capita that is not sustainable.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Refers to the earth’s capacity to regenerate and sustain the needs of its inhabitants.</td>
</tr>
<tr>
<td>SBTool</td>
<td>Sustainable Building Tool is a British rating system for green buildings.</td>
</tr>
<tr>
<td>Økoprofil</td>
<td>Is a Norwegian rating system for green buildings.</td>
</tr>
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1. Introduction

“What is the use of a house if you haven’t got a tolerable planet to put it on?”

Henry David Thoreau

Information, theories and assessments about how human activity affects the environment in a negative way is frequently presented. There have been several environmental movements some more successful than others and the focus on sustainable environmental solutions has over the time been changing. Although its importance is gaining broader acceptance and many areas has improved, there still is a need take the challenge even further. Especially now that, in 2008 it became evident that the world was facing a global economical crisis alongside the environmental crisis and the ongoing social crisis. Many fears that environmental issues will be down prioritize because of the economical situation, while others see that this provides an opportunity to turn our focus on a more sustainable development. Sustainability refers to the use of natural resources in such a way that the earth can continue to meet the needs of all humans, forms of life and future generations. This implies large scale changes. Rethinking the way we use our resources and minimizing our ecological footprint in coherence with a more sustainable economical structure.

The built environment is linked with a big part of the environmental, financial and social problems that exist today. Buildings often stand through several generations. They require a big amount of resources and produce a great deal of waste throughout its lifetime. Subsequently, the demand for sustainable buildings is increasing. Many architect firms recognize this demand and sees that being best on environmental solutions, might become the way of surviving the economical crisis and taking environmental and social responsibility.

The architect is one of the key persons to promote sustainable architecture. They have a big and demanding responsibility as the environment is very complex it requires very complex solutions. Developing sustainable beautiful architecture requires a holistic and long-term approach. In addition, it requires that the architects incorporate new knowledge, tools and processes into their existing landscape of the organization. The role of the management is to lead the organization through this change. Often the reality is that the organization must simultaneously address other changes at the same time, thus making it vital for the organization to be capable of facing multiple changes to be successful.

“This is potentially one of the most challenging periods of architectural innovation in history. While many of the established architects today seem intimidated by the accelerating momentum of change – fearing their stylistic commitments may be under attack – there is no reason why environmental revolution cannot be welcomed as the threshold of great creative era. Here is an opportunity to invent the future on terms that are sociologically and ecologically responsible.” James Wines, President and Founder of SITE Head of the Department of Architecture at Pennsylvania State University (Earth Pledge Foundation 2000)

To understand how the management can successfully face the demands of sustainable architecture it is valuable to look at the theories of environmental-, change- and knowledge management and the psychology, historical, cultural, economic and political aspects of environmental problems.

1.1 Background

The background for this report is that the environmental, economic and social crisis we experience today is highly connected and the world’s organizations are one of the key players in solving the crisis. The construction business is one of the sectors with the highest environmental impact. Thus it is valuable to look at how this sector can change from having a negative impact to a positive one.
The key players in improving the environmental situation are the organizations, governments and individuals. Within the construction business, the architects are one of the key persons to integrate and promote sustainable solutions from the very start of the projects. Thus this report focuses on the role of the architect.

1.1.1 Environmental situation

The United Nations Environmental Program (UNEP) states that the world is experiencing radical changes - socially, economically and environmentally. The global environmental changes may ruin the many advances human society has made in recent decades. It is weakening the fight against poverty and international peace and security may be put at risk. “These issues transcend borders. Protecting the global environment is largely beyond the capacity of individual countries. And we need to focus in particular on the needs of the poor, who already suffer disproportionately from pollution and disasters. Natural resources and ecosystems underpin all our hopes for a better world.”

The environmental problems we face today are interconnected and growing exponentially. The most apparent one is climate change, but it is not the only threat. There are many other alarming signs, such as human population growth, unsustainable economic growth, poverty, resources and biodiversity depletion, pollution and human health problems. (Miller 2000)

Climate Change

Many climate models predicts that a doubling of pre-industrial levels of greenhouse gases, reached between 2030 – 2060, will most likely result in a rise in global mean temperature of 2-5°C. If the emissions continue at the steady rate as it does today it will be trebled by 2100 and calculations suggests that there will be a rise of 3-10°C. “A warming of 5°C on a global scale would be far outside the experience of human civilization and comparable to the difference between temperatures during the last ice age and today.” (Stern 2007)

A rise in temperature might further trigger the release of greenhouse gases trapped in the permafrost, creating a risk of even higher temperature changes. In addition, higher temperatures intensify the risk of droughts, floods, more intense storms and sea level rise. (Stern 2007)

Human population growth and the earth’s carrying capacity

UNEP ranks human population growth as the number one threat to the global environment. In January 2010 the population is estimated to have reached 6,8 billion and they predict that it may reach between 7,9 and 10,9 billion by 2050, depending on the actions that are taken today. The rapid population growth is jeopardizing the earth’s capability to balance and regenerate the resources we use. Every individual of the global population requires energy, space and resources to survive. When combining exponential population growth with excessive consumption, the environmental problems multiply.

The earth has a limited carrying capacity, “the number of individuals of a given species that can be sustained indefinitely in a given space”. (Miller 2000) To estimate the carrying capacity of the earth, it is sought to find the maximum number an ecosystem can support, which means that the maximum number will be living under the lowest possible standard. To support the maximum number people it would mean that they have to sacrifice most luxuries such as cars, recreation, fine arts and higher education. This is called the cultural carrying capacity and it is always less than the biological carrying capacity because human beings use more resources than is absolutely necessary. (Winter and Koger 2004)

Since the earth is an isolated habitat, the population cannot migrate to a new one, it is vital that the population find a balance with the resource base. If it fails to find a balance and the population grows too quickly, there is a severe risk that the population can crash. (Winter and Koger 2004)
Such crashes have happened both in human and nonhuman populations:

Archeological evidence show that the Maya developed a complex civilization (2000 B.C. - 800 A.D) on the fragile soil of tropical forests, in an area covering parts of Mexico, Guatemala, Belize and Honduras. Clearing of forest and planting supported the population, but as the population grew and land that needed to recover was overused. This resulted in that the population crashed around 800 A.D. Within a short period the cities were abandoned and only a small number of peasants continued to live in the area. Remains tell that widespread malnutrition killed a massive number of the population. (Winter and Koger 2004)

Pictures 1: *The Mayan civilization* from www.mayancivilizationinfo.com

**Unsustainable economic growth**

Most countries seek economic growth, which is reached by greater production of products and services. This is possible through increased use of resources and energy combined with population growth and greater consumption per individual. Economic growth is usually measured in a country’s gross national product (GNP). (Miller 2000) When the success of countries is measured in GNP and not in an ecological context, it is easy that one can get the illusion that an infinitely economic growth is sustainable. (Aristos 2003)

**Resources and biodiversity depletion**

Renewable resources are only renewable if it is not used faster than the natural processes renew them. If the resource is used at a higher rate than its natural replacement rate, the resource is going through degradation and facing depletion. Resources that take millions to billions of years to renew by natural processes, such as coal, oil, natural gas, metals, clay and nutrients, are nonrenewable resources. (Miller 2000) The peak of oil production is predicted to arrive already within 15 years. (Worldwatch Institute 2008)

Some of the major types of environmental degradation are urbanization of productive land, wetlands destruction, deforestation, groundwater depletion, livestock overgrazing and reduction of biodiversity by elimination habitats and species. Nearly one in six species of European mammals is threatened with extinction, and all currently fished marine species could collapse by 2050. (Miller 2000)

“Biodiversity is the foundation of life on earth and one of the pillars of sustainable development. The conservation and sustainable use of biodiversity is an essential element of any strategy to adapt to climate change.” (UNEP)

**Pollution and waste**

Pollution is any type of emission to the atmosphere, water or soil that are jeopardizing the health and well-being of the earth and its inhabitants. There are three factors that indicate how destructive a pollutant is, its chemical nature, its concentration and its persistence. (Miller 2000)

**Human health**

UNEP further highlights that it is evident that the environmental problems is directly linked to human health problems such as several types of cancer nutritional deficiency and respiratory illnesses. Each year, urban air pollution causes 2 million premature deaths each year, mostly in developing countries. (Worldwatch Institute 2008)
Sustainable development

Miller (2000) presents some guidelines for working with the earth instead of producing problems:

- Leave the earth as good as or better than we found it.
- Take no more than we need.
- Try not to harm life, air, water or soil.
- Help maintain the earth’s capacity for self-repair.
- Don’t use potentially renewable resources faster than they are replenished.
- Don’t waste resources.
- Don’t release pollutants into the environment faster than the earth can dilute or assimilate them.
- Emphasize pollution prevention and waste reduction.
- Slow the rate of population growth.
- Reduce poverty.

Sustainable development occurs when the society manages to balances the earth’s environmental capital and population size, without disrupting the earth’s ability to absorb environmental impacts, for future generations. So far many sustainable actions are done and it is hopefully not too late to replace our “earth-degrading actions with earth-sustaining” ones. The solution is to look at how the earth sustains itself and adapts to changes, to learn what sustainable development is. (Miller 2000)

1.1.1.1 Built environment

Population growth requires an increased amount of buildings and since buildings require great amount of natural resources and affects the environment throughout its life time, the building sector is an important area where there is great potential to change the negative spiral.

The construction business in Norway is called the 40% sector because the built environment accounts for about: (National Association of Norwegian Architects (NAL) www.arkitektur.no)

- 40% of energy use
- 40% of all CO2 emissions
- 40% of raw materials use
- 40% of waste to depot

According to Williamson, Radford and Bennetts (2003) Buildings are connected with emissions into the environment such as climate change gases, substances that deplete the ozone layer, smog creating substances, toxins, pollution from inappropriate waste disposal and nuclear power plants present the risk of accidental emission of radioactive substances. Buildings demand extraction from the environment such as non-renewable resources and renewable resources. Fossil fuels and uranium are one of the globally major non-renewable resources used to power buildings and provide energy to manufacturing, transporting and constructing the buildings. Other non-renewable resources such as mineral deposits and metal ores appear to be decreasing rapidly in the last century. Renewable resources such as wood are limited to its production potential. Solar power, wind, tide and wave energy are being implemented but at a rather slowly rate. The primary reason for this is that at present time non-renewable resources for energy are cheaper. Clean water is not only vital to life, it is also important to the construction and operation of buildings. Globally clean water is one of the most important and increasingly scarce resources we use. Water is a critical issue for the design of sustainable buildings including its related landscape, because of the increasing demands for water storage facilities and associated destruction of natural areas, the problems of over-extracting ground water supplies, the problems of ground salinity and the increasing costs of requirements to decontaminate polluted sources.
1.1.2 Financial situation

At the same time as the world is experiencing an emerging environmental crisis the world is faced with a financial crisis. Exponential growth and the search for short term profits are some of the major driving forces for both of the crisis. Even if there are parallels between the causes of the current global financial crisis and the emerging global environmental crisis we continue to think that saving the planet will hurt the economy, and that saving the economy means we cannot save the planet. The truth is that the economy cannot exist without a healthy robust environment.

Prof. Paul E. Hardisty, global director in sustainability and EcoNomics at WorleyParsons state that inaction on climate change might result in widespread damage to the world’s economy and the longer we take to make the necessary changes, the more it will cost us overall. From a purely economic cost-benefit perspective, investing in preventing climate change is a very good deal.

It is encouraging to see that the world’s governments are capable of acting quickly when faced with a crisis. A similar response is needed to deal with the global environmental crisis.

This unwary period represents a unique opportunity to create profound and widespread changes to establish long-term environmentally, socially and economically sustainable improvements. (Middle East Economic Survey www.mees.com)

The World Resource Institute (WRI), an environmental think tank, highlights the signs of this change already starting. They are experiencing that investing in companies that threaten the health of ecosystems can be bad business. Not just because of reputational risks, but also due to their dependency of healthy ecosystems and the services they provide. (World Resource Institute www.wri.org) The Durst Organization, co-owner and developer of Bank of America are recognizing the financial benefits of sustainability and states - “What does green mean? To us, green means business” (www.durst.org)

1.1.3 Social situation

The environmental and financial problems are also linked with social problems. Brown & Flavin (1999) state that today 1.1 billion people of the world are undernourished and 1.2 billion have no access to clean water. The inequalities in the distribution of GNP have grown steadily over the last decade, which is clearly illustrated when comparing GNP per capita in India and Japan in 2008:

![Figure 1: GNP per capita in India and Japan 2008. (Central Intelligence Agency, www.cia.com)](http://www.cia.com)

The distribution of the world’s total consumption also illustrates great inequalities in the world. 20% of the world’s people in the highest-income countries account for 86% of the total private consumption, while the poorest 20% consume only 1.3%. The imbalanced distribution of wealth and resources leads to an enormous waste and abundance for a small percentage of the world’s population, while there a great suffering in the resource-starved regions. (Clean Water Action Council of Northeastern Wisconsin, Inc, www.cwac.net)
2. Objective

The main objectives are to:

- Describe how the management can support the work with sustainable architecture in relation to the information given in the interviews.

- Describe the communication and cooperation in the building chain and how it can support sustainable architecture.

- Describe the forces working against sustainable architecture.

The following objectives are presented in chapter 5. *Sustainable Architecture*:

- Describe the benefits of sustainable architecture

- Present examples of sustainable architecture

- Describe the current trends and the visions within sustainable architecture

- Describe the barriers to sustainable architecture.

- Describe the tools for sustainable architecture

2.1 Limitations

When the report talks about sustainable architecture it not only includes environmental issues but also social and economical aspects. Sustainable architecture includes whole cities which are often referred to as Eco cities. In this study the focus lies only on buildings, but when looking at environmental impact in 1.1.1.1 Built Environment the numbers are considering the whole impact of the built environment.

The unit of research is limited to three architectural firms of different sizes. This limitation provided the opportunity to do in-depth interviews and observation studies in one of the companies.
3. Method

This chapter describes the research methods and approaches used by the researcher to ensure coherence and viability. Reasons for why the different methods and approaches have been chosen are explained and a review of its benefits, weaknesses, reliability and validity are incorporated to serve as a basis for evaluation of the study’s quality.

To achieve the goals in this paper a qualitative research method is chosen. Qualitative research may be a preferable method when the goal is to understand human perspectives, social dynamics and organizational structures. (Trost 1993) Typical qualitative questions focus on “how social systems operate, how individuals relate to one another, how individuals perceive one another, and how the interpret their own and other’s behavior”. (Jackson 1995) These parameters may be difficult to recognize by quantitative methods where the focus is on numerical description rather that verbal descriptions. (Trost 1993) The researcher use quotes from interviews and experience gathered in the field studies to present the result.

To secure that the research method follows the objective, the project description is simultaneously referred to throughout the research process.

The interviews and observation studies are done by one researcher, who has experience from several studies where interviews and field-studies were the main methods. This experience provides the researcher the understanding that being structured, open-minded, critical and clear are some important aspects when planning and conducting interviews and field-studies.

3.1 Data collection

The data collection in this research is done through, literature surveys, in-depth interviews and observation study.

3.1.1 Literature

Reviewing literature is a way to find out the state of scientific knowledge on a subject. It may be difficult to find scientific published results on the specific topic of study. However it can be easier to find literature on different variables or underlying areas within the topic. (Jackson 1995) When reviewing literature it brings focus to the study and an understanding for what is known and unknown in the area. There is a risk that literature reviewing may decrease the researchers openness and resulting in bias thinking. To reduce this risk it may be beneficial to do “the literature review simultaneously with fieldwork, permitting a creative interplay among the process of data collection, literature review, and researcher introspection”. (Patton 2002)

In this research, literature is used to collect information on how to conduct a scientific research and gather data to find valuable aspects on the research question. Further to map out the state of scientific knowledge on the research area and to understand its fundamental aspects when developing the questions for the interviews. Literature recommended by professional within the subjects, such as a psychologist, architects and professors within architecture and environmental subjects, is emphasized. The literature is simultaneously reviewed to remain an open and subjective approach in the research process.

3.1.2 In-depth interview

In order to collect data to answer the objectives of the research, in-depth interviews are chosen. Conducting in-depth interviews are a method to collect information of individuals’ perception of their world, in this case how an employee or the management perceives the organization, their own and peers’ situation. Usually it is not necessary to use standardized questions, it is rather recommended to identify the areas to be covered and discuss them under the interview. However, a set of questions is developed, based on the theoretical framework, to ensure that all areas of interest are covered under the interview. The set of questions is presented in Appendix 1 Interview questions. Jackson, W. (1995) highlights that when interviewing high status people, like corporate executives, they may not respond well to a too structured and strict questionnaire being read to them. Therefore the format of the interview is flexible with a more conversational style and themes that the respondent brings up are freely pursued for further discussion. The interviews are recorded and transcribed to written format. It is then translated from Norwegian to English with a high focus on remaining the meaning of the answers in the translated text. From the interviews, quotations that illustrate the interesting aspects of the situation are selected to answer the objective. In order to present a broader understanding of the situation the results from the in-depth interviews are combined with observation studies.
3.1.3 Observation study

Observation studies may be divided into two types of scenarios. One is participant observation studies and the other is covert observational studies. The first is characterized by that the researcher is involved in the group. The other is when the researcher is making observations without the group knowing it is observed. "Participant observation studies try to understand institutions, gangs, groups, and even whole cultures. These studies are holistic because they try to understand the whole group." In this study, the researcher is openly doing observations and being involved in the natural settings of the organization. Because understanding aspects, open and hidden forces, rules and cultures in an organization require a holistic research approach. To avoid preconceived ideas the researcher follows recommendations on being open-minded and to see the world through the eyes of the participants. (Jackson 1995)

3.2 Unit of research

In this study three architectural firms of varying sizes and environmental experience are interviewed.

*Company 1* consists of 100 employees. They have done both national and international projects and are known for integrating landscape and architecture. Teamwork throughout the design process is essential and they focus on ethics, corruption issues, climate responsibility and sustainable development.

*Company 2* consists of 34 employees. They are one of the few architectural companies in Norway that are certified after the environmental certification system called *Miljøfyrtårnet* (3rd party audit) and they strive to reduce the built environment’s environmental impact. Mainly they do projects in Norway and they have a broad competence of architecture, communication, environment and planning. Environment and energy aspects are naturally included as they work closely with a Consulting Engineering Company.

*Company 3* consists of 20 employees divided on to divisions. They are also certified after the environmental certification system called *Miljøfyrtårnet* (3rd party audit) and they use their competence within architecture and planning to contribute with a sustainable development in the northern areas.

A company is an aggregation consisting of many individuals with different roles, thus it is necessary to choose individuals that can represent the diversity. In this study the participants chosen to participate in the in-depth interviews are a representative from the management, middle-management and an architect in the biggest company, one from the management and an architect in the middle sized company and one from the management in the smaller company. The observation study is conducted in *Company 1* over a period of three months.

The unit of analysis is representative of the company. The structure of the companies are quite flat, but consist of a hierarchical structure of responsibility, thus using a represent from the management, middle-management and employees illustrates the company well. Doing in-depth interviews in companies of different sizes and with varying experience with change implementation, serves as a basis to get a broad view on the matter.

To secure the confidentiality of the interviewees and their organizations, the names are excluded. The quotations presented in the research paper only refer to their position in the organization.
4. Theory

This chapter presents the relevant theories to understand the current state of knowledge within the area of study. When the interview questions were developed, these theories were the fundament to insure that the whole area of study was covered. It also serves as a basis when comparing the theory with the findings from the interviews.

4.1 Management

When an organization seeks to support sustainable development, they are faced with challenges with knowledge management and complex, competing and changing demands. In addition they may experience great internal and external forces working against it. To strengthening the organizations ability to face these challenges, it is valuable to understand environmental, change and knowledge management and the psychology, historical, cultural, economic and political aspects of environmental problems. This imposes great demands on the leaders for sustainable development.

“Leaders for sustainable development will, across time, define a new business logic. While the dominant language and metrics of that logic must include refinements of the conventional corporate strategic concerns about time, quality, cost reduction, distribution, and critical staffing issues, one can begin to see the emergence of these new leaders in the realm of corporate environmental management.” (Schmandt and Ward 2000)

4.1.1 Environmental management

Environmental management (EM) is when the management incorporates the values of sustainable development into the organization’s visions, goals, actions plans, programs and practices and seeks to continuously improve the management system. An important role of EM is to educate, teach and motivate employees, peers, external consultants, customer and the community to understand and adopt sustainable habits. In order to improve the environmental impact EM seeks the highest degree of eco-efficiency by reducing consumption of energy, raw materials and nonrenewable resource and applies the best and cleanest technologies available. Further it seeks to minimizing waste, recycling, reusing and eventually disposing unavoidable waste in a way that poses no threat to the environment. It is important with transparency, dialogue, participation and control by the groups that are directly affected and residents in general. (Bechtel, Churchman and Ts'erts'man 2002)

One can wonder whether leaders can motivate people to give room for restraints or radical changes in their life style in the current times of a paradise-like global consumerism. If one look to history, one finds examples of leaders who preached about the powers of restraint in credible ways. Leaders such as Winston Churchill and his famous appeal about “blood, sweat and tears” and Caesar communicating the subtle necessities of Roman sacrifice. The both were individuals who discover in us the emotional awareness it takes to get a difficult job done, even if it requires scarification and restriction. Environmental leaders face challenging sets of demands that differ from their peers in other more defined and established departments, such as: (Schmandt and Ward 2000)

1. They must achieve regulatory compliance.
2. They must go beyond compliance to recognize business opportunities while being able to take on prudent business risks.
3. They must work skillfully with a wide range of external stakeholders, not all of them friendly.

The first requirement is reached both by understanding legal, engineering and scientific needs and also making the objective perceivable to others within the organizations, especially the chief executive officer and product champions. Secondly it is important to balance the regulatory demands without losing the positive aspects of risk taking, innovation and business advances. The third is accomplished by answering to public expectations by satisfying key stakeholders. These goals are not reached alone, the leader establishes a team who holds and brings forth them all. The leader only serves as an example on how these goals are possible and profitable. (Schmandt and Ward 2000)

Schmandt and Ward (2000) further present nine important points for the environmental leader to consider.

1. Forget about blame and find what works, by focusing on the solution, rather than opinions and positions.
2. Build a broad and deep network of personal friendships, associations and affiliations, by recognizing the importance of personal relationship and discovering the value latent in networks.

3. Cultivate risk, ambiguity and uncertainty as sources of powerful change. Tolerance of productive ambiguity is important when searching for new opportunities and change.

4. Select brilliant, reliable deputies. This will allow the leader to maintain compliance as she stretches for the further goals that compound value throughout the organization.

5. Check your instinct against your clients’ needs by knowing what your client needs.

6. Replicate success, using lots of small steps to clear the top. If the goal is to jump a 6 meters hurdle, it is better to divide it up three two meters hurdles, making the goal possible to achieve.

7. Make the future of the organization promising to everyone in it.

8. Use stories and metaphors to reinforce the goals of the organization and sense of belonging.

9. Acknowledge the importance of everyone’s role.

The goal of the last three points is to compound the value of everyone in the organization, by making the future of the organization promising, taking everybody seriously and using “tribal” stories where the actions of the individual cohere into a meaningful message. (Schmandt and Ward 2000)

In general environmental leaders must provide sufficient insight regarding the difficult choices we are facing and they must have “an extraordinary range of knowledge, diplomatic and political talent, dispute-resolution abilities, basic business skills and a humanism in their decision-making that reaches beyond this quarter’s balance sheet”. (Schmandt and Ward 2000)

4.1.1.1 Tools

There are several tools that are valuable for EM by supporting a continuous improvement within environmental issues, such as Environmental Management Systems (EMS), Environmental Auditing (EA), and Environmental Performance Evaluation (EPE). ISO 14000 and Eco-Management and Audit Scheme (EMAS) are correspondingly international and European standards for guiding the organization to address environmental issues and give credit to organization’s who continuously improve their environmental impact. (www.ntnu.no)

EMS is a framework to managing the organization’s environmental issues in a structured, wide-ranged and transparent way. The key elements of an EMS are to formulate a policy of the environmental commitment and environmental goals, develop action plans, map out the organization’s environmental impacts, train and keep the employees updated and continuous review the management. It is recommended to follow the concept of Plan-Do-Check-Act (PDCA) to help focus on continuous improvement. (www.wikipedia.org)

EA is about assessing the organization’s environmental management and performance, which is a helpful tool to map and understand the state of the organization.

EPE (ISO 14031) is a tool to measuring, analyzing and assessing the organization’s environmental aspects. To do this assessment it is important by identifying the Environmental Performance Indicators (EPI). This assessment provides a foundation to develop goals and action plans and to compare with other organizations within the same business area. (www.ntnu.no)

Environmental Impact Assessment (EIA) is an assessment of the environmental impact of a proposed project. It is a valuable tool for the management when deciding whether to go through with the project or not. (www.ec.europa.eu)

To calculate and evaluate the impact caused by a production process, Environmental Accounting (EAc) and Cleaner Production (CP) are useful tools. EAc helps to understand the economical aspects of the impacts on the natural environmental, by both looking at the contributions and the costs. (www.unpei.org) CP analyses the flow of material and energy in the organization and developing reduction strategies to minimize waste and emissions. (www.wikipedia.org)

The International Network for Environmental Management (INEM) is presenting a set of web tools that are helpful when implementing and improving the performance of an EM (www.inem.org):
- **EMAS Tool Kit for Small Organizations** – provides a step-by-step guidance and tools for implementation of an environmental management system.

- **Environmental Weather Map** – helps the mapping the environmental climate in the organization.

- **Environmental Policy Checklist** – evaluates the viability if the organization’s environmental policy.

- **Environmental Statement and Environmental Report Checklist** – evaluates if the report and statement is complete and effective and whether the report meets the requirements.

- **Eco-design Health Check** – evaluates how well environmental design is incorporated.

To map a product’s environmental aspects there are several tools to understand the whole product chain and the environmental impact through its life time. Tools such as Life Cycle Assessment (LCA), Life Cycle Screening (LCS), Life Cycle Costing (LCC), Material, Energy and Toxic-analysis (MET), Material Input per Service Unit (MIPS), Design for the Environment (DfE) and Eco Labeling (EL) are valuable in this aspect. (www.ntnu.no)

### 4.1.2 Change management

Change management (CM) is a field of knowledge regarding a structured process of transformation into a desired state, weather it concerns a single individual, a small constellations or a big organizations.

Organizations are facing increased rate of changing environments, which makes it increasingly important that they are able to respond fast in order to survive and prosper (Porras and Silver 1991).

Changing one person is very hard, but changing 100 or 1000 in an organization can be an even harder challenge. Often the management believes that change happens by making people think differently, but that is not the case according to Kotter J. and Cohen D. in their book *The Heart if Change*. They state that change happens when you make people feel differently. It is more important appealing to the heart rather than the mind. The force that people get when people responding emotionally to an issue, is a natural and powerful motivation for action. “They see, then feel, then change”

To achieve an organization that is more capable of facing changes, Kotter J. and Cohen D (2002) advise the management to look at the following eight steps:

1. **Increase urgency** so that people start telling each other “Let’s go, we need to change things!”

2. **Build a guiding team** powerful enough to guide a big change.

3. **Get the vision right** and create sets of strategies.

4. **Communicate for buy-in** with simple and heartfelt messages sent through multiple channels.

5. **Empower people** by removing obstacles to the vision.

6. **Create short-term wins** that provide momentum.

7. **Maintain momentum** so that wave after wave of change is possible.

8. **Make change stick** by nurturing a new culture.

A description of the eight steps is in Appendix 3 *Change management – Eight steps to increase change capability.*

#### 4.1.2.1 Tools

There are several tools for the management to use when they are leading the organization through a change process. First it is valuable to map out the organization’s change capability. Inspired by Rudolfsson (2005) the following questions are formulated to evaluate the organization’s change capability and used in the in-depth interviews:

1. How is the company structure? Top-down controlled?
2. Are the internal boarders closed or open?

3. Cooperation with external experts? (Manufactures, engineers, biologist, etc.)

4. Is development controlled and structured by the management? Or is it encouraged to happen in all departments?

5. Does the management provide answers or do they support the staff to find the answers themselves?

6. How is the level of motivation to take own initiatives and what improves this motivation?

7. Is it allowed to make mistakes?

8. Are there any hidden laws? To people find them unnecessary? Are they a prohibiting factor?

9. How is the atmosphere and attitudes towards change?

10. Is the focus on the customer’s needs?

11. Is it important to be unique?

12. How is the work load, tempo and stress level?

13. How do the employees know whether it is going good or bad with business?

14. What is the distribution between the project with new solutions and known solutions?

There are several tools at www.change-management-tool.com to support mapping some of the questions above and additional tool to measure the organizations change capability.

Understanding the organizations history and the trends is valuable to become aware of the common background and organization’s change experience. It is beneficial to use a tool called Timeline to let the employees describe their own experience and compare them with those of their colleagues. See Appendix 4 Organizational Timeline: Writing the History of Your Organization for worksheet and explanation of the process. (www.change-management-toolbook.com)

Further using Strength-Weaknesses-Opportunities-Threats (SWOT) analysis is also valuable in CM. SWOT highlights questions regarding, objectives, customer needs, how to be in the profit zone, improvement of services and to differentiate internal from external framework conditions.

To support individuals, teams and the whole organization to see the positive opportunities of change it is good to use the tool Analyze Change Drivers on Different Levels of Change to understand and reflect on the aspects affecting them. See Appendix 5 Analyze Change Drivers on Different Levels of Change for worksheet and explanation of the exercise. (www.change-management-toolbook.com)

When facing change organizations experience different levels of complexity, uncertainty and agreement of what should be done. Ralph Stacey’s Agreement & Certainty Matrix supports the management to select the relevant measures to be in the best zone for facing changes. The matrix and description is presented in Appendix 6 Agreement & Certainty Matrix. (www.change-management-toolbook.com)

4.1.2.2 Multiple change management

As the rate of globalization and technological innovations continues to increase, organizations often have to implement a number of strategic and organizational changes at the same time or over a relatively short time frame.

Meyer C. B. and Stensaker I. G. (2007), highlights two key challenges that organizations face when pursuing multiple changes. Continuous adverse effects on daily operations and too little focus on change results might make employees find that the change is useless as they see few results and it might cause middle managers to attend more to their position for future changes rather than the daily operations and their subordinates.

Successful managers attended to these challenges by applying five change management techniques:

1. Emphasizing organizational memory and forgetting.
2. Thinking in the present and the future tense.

3. Creating flexible change routines.

4. Selectively including people.

5. Alternating temporary and permanent human resources.

These five techniques are in contrast to most change management recommendations and indicate that leaders should let their employees focus on their daily tasks and protect them from too much involvement in change related activities. This will ease the pressure on the individual and increase the capacity of long-term and multiple changes. (Meyer and Stensaker 2007) See Appendix 5 Multiple change management techniques for description of the techniques.

4.1.3 Knowledge management

"Business organizations worldwide increasingly recognize the effective use of knowledge as a key-differentiating factor and as the most important resource for potential economic success." (Stewart 1998)

In a creative organization where complex problem solving is a primary component, such as in an architectural firm, good knowledge management (KM) is of great value. Environmental solutions require holistic and long-term thinking and the path towards more sustainable architecture can be a new field of knowledge for many architects. KM is a multi disciplined way to make the best of the intellectual capital to achieve the organizational objectives. The focus lies in acquiring, creating and sharing knowledge and developing cultural and technical foundations to support the processes. (www.unc.edu) A successful KM provides a work environment where the employees share their best practices, improve the quality of their knowledge and support each other to solve difficult tasks. Ease the burden on the individual employee by developing systems that capture and increase intellectual capital. (www.crito.uci.edu) In projects where environmental solutions are demanded, it is necessary for the architect to look at a great amount of data and information. The problem is that data and information is not knowledge until we know how to use its valuable parts.

Nonaka I. and Hirotaka T. (1995) divides an organization’s intellectual capital in two types of knowledge, explicit and tacit knowledge. Explicit knowledge is objective and is communicated in the form of words and numbers. It can be expressed in the form of manuals, articles, patents, pictures, videos, audios and software. Tacit knowledge is subjective and is not easily expressible because it is embedded in individuals and their intuition. It is difficult to process tacit knowledge in a systematic or logical manner. They point out that explicit knowledge is only the tip of the iceberg and that tacit knowledge is the hidden and biggest part of the intellectual capital. Therefore, it is important to convert tacit knowledge into words and numbers, to make it understandable and easily communicated in the organization. Another way of sharing tacit knowledge is by encouraging conversations and communications.

To make the most of an organization’s intellectual capital, it is important to share knowledge and let it be the foundation for cooperation. When knowledge is shared, there is a synergetic effect that will bring about better solutions. Knowledge is continually improved, adapted and refreshed, when it is encouraged to let knowledge flow freely between employees. This is achieved when there is an atmosphere of that everyone has something to learn and share. (Ramalingam 2006)

Thus, a good KM program should support the organization in one or more of the following: (www.unc.edu)

- Foster innovation by encouraging the free flow of ideas
- Improve decision making
- Improve customer service by streamlining response time
- Boost revenues by getting products and services to market faster
- Enhance employee retention rates by recognizing the value of employees' knowledge and rewarding them for it
- Streamline operations and reduce costs by eliminating redundant or unnecessary processes
Marla M. Capozzi (2007) writes in an article in *First Monday* (www.firstmonday.org) a few additional thoughts that are important to consider when implementing KM:

- Not all knowledge should be captured, not everything people know can benefit an organization.
- Technologists care about technology — users care about content.
- Collaboration can be unproductive and can be designed to be more productive.
- People never do what they say they will do, so don't ask them, prototype solutions as early as possible.

### 4.1.5.1 Tools for knowledge and learning

This section presents helpful tools that can be beneficial for the management when seeking to strengthen the organization’s ability to acquire knowledge.

Ramalingam B. (2007) and the Research and Policy in Development (RAPID) have researched on the importance of knowledge and learning tools. They have found that if the tools are applied effectively, it has a potential to transform the efficiency and effectiveness of development. To be successful with these tools it is important to integrate them with other organizational processes.

Ramalingam presents the tools in a framework of five key organizational competencies inspired by the work of Chris Collison and Geoff Parcell in their *Learning to Fly* series. The goal of the framework is to improve the effectiveness of the following five important competency areas:

1. **Strategy development**
   
   This competency relates to how an organization might start to look at its knowledge and learning in a strategic manner. The tools presented provide different frameworks which can be used to plan, monitor and evaluate knowledge and learning initiatives.

2. **Management techniques**
   
   If leadership is the process of working out the right things to do, then management is the process of doing things right. Here are a range of simple approaches, from assessing managerial responses to mistakes, to assessing the forces for and against stated organizational changes, which might prove useful to managers working towards the learning organization.

3. **Collaboration mechanisms**
   
   When working together with others, the whole of our efforts often proves to be less than the sum of the parts. Because often there is not enough attention paid to facilitating effective collaborative practices. The tools in this section can be applied to reflect on the workings of teams, and to help strengthen relationships and develop shared thinking.

4. **Knowledge capture and storage**
   
   Knowledge and information can leak in all sorts of ways and at all sorts of times. To make sure that essential knowledge is retained by an organization requires, a range of techniques can be applied, from traditional information management tools such as shared drives, as well as more modern techniques such as blogs and knowledge based exit interviews.

5. **Knowledge sharing and learning**
   
   So much of effective knowledge and learning is about two-way communication which takes place in a simple and effective manner, and applying simple techniques to try and build on past experiences to improve activities in the future. These essential tools are covered in this section.

Full descriptions of all tools within the five areas are listed in Appendix 6 *Learning and knowledge tools.*
4.2 Understanding environmental problems

It is valuable for the management to understand the psychology, cultural, historical, economic and political aspects of environmental problems. This chapter presents these aspects in brief.

“I find it quite striking how psychological aspects act as a prohibiting factor. They are more difficult to address, since they are more undefined.” Mari Bergset, Snohetta AS

4.2.1 Psychology of environmental problems

“Overconsumption is a form of madness and the environmental destruction this madness causes destroys us along with it.” Theodore R. (2001)

This statement makes psychology, the science of human behavior, an important area when understanding and working with sustainable development. The management at an organization must be the main driving force and when understanding the psychological aspects they are more equipped to support the employees to move forward and work with developing solutions rather than being paralyzed by the problem.

“The environmental situation today is bad news and it continues to get worse. No wonder we cannot stay tuned for very long. To do so would be too depressing, perhaps too terrifying. So we turn our attention to our present concerns: family obligations, work or school, enjoying friends, paying bills.” (Winter and Koger 2004)

Winter and Koger (2004) find this reaction very understandable and it is very consistent in an evolutionary perspective. Our ancestors adapted to threats that were sudden and dramatic, they had no need to track gradually worsening problems or assaults that took many years to manifest. This led to a species that is short sighted and has difficulty responding to slowly developing potential catastrophes. At the same time we are also very adaptable to dramatic and rapid cultural evolution such as technological and industrial revolutions bring about. They suggest that this capability of adapting to rapid behavioral change might be the solution to reverse the current negative environmental trends.

Most people are aware of the environmental problems but the reaction usually diverts in two directions, the optimistic and the pessimistic. The optimistic argues that the population growth is good because people eventually produce more than they consume. Human beings are not limited by the carrying capacity of an ecosystem, because humans have the intelligence to redesign their habitat by inventing technology and the free market will allow human ingenuity to flourish. Therefore human products and human well-being will continue to boom. The pessimistic find the environmental problems hopeless and that the only solution is by converting to a new ecological worldview. Others may say that they are not directly causing the problem themselves and the little negative impact they cause does not make any difference in the big picture, thus claiming that it is not their problem. (Winter and Koger 2004)

Interesting aspects drawn from Freudian-, Social-, Behavioral-, Cognitive psychology, related to environmental issues, provides insight about changing individual behavior, thoughts, feelings, physiological reactions or beliefs is presented in Appendix 7 Freudian-, Social-, Behavioral-, Cognitive psychology of environmental problems.

Winter and Koger suggest six operating principles for how to support ones employees to handle environmental issues in a more solution oriented way:

1. Visualize healthy ecosystems
2. Work with small steps and big ideas
3. Think circle instead of line
4. Consider ways in which less is more
5. Practice conscious consumption
6. Act on personal and political levels, especially community participation
4.2.1.1 Holistic approaches – Gestalt and Ecopsychology

Gestalt means a description of a complete and more meaningful form and thus Gestalt psychology regard the human mind to focus on the whole picture instead of only its parts. The brain is capable to see the whole picture even if there are any parts missing. The objective of Gestalt psychology is to regard the whole problem to find solutions. (www.gestalt.no) Ecopsychology combines psychology and ecology and its objective is to recognize ways to achieve a more sustainable society. It regards that even if the human mind is adapted to urban cultures the qualities of the natural world are of great value for wellbeing and comfort. The human mental health is not only linked with internal or social issues but also external relationship with other species and ecosystems and it suggests that a healthy ecosystem not only benefits physical health but also psychological health. (www.johnvdavis.com) Both gestalt and ecopsychology emphasize a holistic approach to sustainability.

Holism means that the whole is more than the sum of the parts. Our environmental problems are caused by a failure to see the whole. It cannot be adequately addressed if we focus exclusively on individuals as isolated actors. The holistic approaches stress our interconnected existence within a complex system. (Winter and Koger 2004) Architects must acknowledge the effects of buildings on people, the society and ecosystems and this holistic knowledge is necessary for developing sustainable architecture.

“The tragedy of the commons” illustrate that resource depletion can be driven by the fear that others will use it first. Perhaps one would hope that scarcity of a resource would encourage moderation, but research shows that the opposite occurs, scarcity of a resource increase the rate of depletion due to over exploitation. The key to encourage cooperation instead of self-defeating competitive behavior is to highlight the feeling of group membership. Some ways to increase the feeling of group membership is by: (Winter and Koger 2004)

1. **Limit group size** so that individuals feel more responsible to it
2. **Promote communication** between group members
3. **Appeal to altruistic norms** so that individuals see that the success of the group is important

Social pressure is also an important factor. When it is not socially accepted to conduct unsustainable behavior, sustainable behavior will be rewarded and promoted. Further to successfully address environmental problems it is necessary to see that we are interconnected with the nature and that we are dependent on it. Gestalt and ecopsychology suggests that we achieve this by being in and experiencing the nature with all our senses. This perspective leads to sustainable behavior that is not based on self-sacrifice or self-denial, but out of a sense of love and common identity. The feeling of being a part of nature makes it equally important to protect the nature as much as we would protect ourselves. (Winter and Koger 2004)

Ecopsychology argues that the whole of the cosmos can be considered to be a single great organism with feelings, intelligence and soul. The environmental problems are regarded as symptoms of the Earth’s “disease”. Seeing the Earth as a living being helps us identify with its well-being. Lovelock with his Gaia theory sees that if the Earth takes a sudden turn to the worse, for humans, other species will evolve to fill the available niches, whether or not humans survive. Human existence is dependent on the current balance of the Earth’s regulatory systems, but human survival is certainly not assured.

Despite understandable skepticism, mainstream psychologists recognize the relationship between human beings and nature, that when ecosystems are distressed human beings are distressed. (Winter and Koger 2004)

### 4.2.3 Historical and cultural aspect of environmental problems

Some say that humans’ relationship to nature has changed over time. At the same pace as we separate us self from nature we take less care of it and miss manage it. The depletion of natural resources that we see today may on the other hand be a typical human act that has always been done and since the world’s population is so much bigger than it has ever been, the effects have grown equally as big. To understand how humans have affected the natural environment throughout its existent, it is interesting to look at some of the major eras from 7500 BC until today. I.G. Simmons (1993) derives the global history of human cultures, its affects on environment and signs of conservatism in the eras presented in Table 1: Historical and cultural aspect of human environmental impact. The focus is on what impact and conservation methods that where introduced or specifically relevant to the refered era.
**Table 1: Historical and cultural aspect of human environmental impact. Illustrated by Haug**

<table>
<thead>
<tr>
<th>Era</th>
<th>Activity</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting-gathering and early agriculture (7500 BC –)</td>
<td>No sophisticated technology, Seasonal movement, and no abundance of possessions</td>
<td>Affected to some extent, but less than future cultures, Elimination of key animal species, Controlled fires</td>
</tr>
<tr>
<td>Riverine civilizations (4000 BC – AD 100)</td>
<td>Irrigation technology, Improved health conditions and population growth, Hunting and gardening for pleasure, Monumental projects and warfare</td>
<td>Manipulated the environment to a great extent and the effects are still present, Construction of canals and straight ditches, Strengthening of the natural river banks, Conversion of wild land to cultivation fields, lakes and swamps.</td>
</tr>
<tr>
<td>Agricultural empires (500 BC – AD 1800)</td>
<td>Water storage technology, Terracing, Selective breeding</td>
<td>Manipulated the environment to a great extent and the effects are still present, Establishments of cities, Animal breeding, Food production and cultivation of e.g. cotton and tobacco, Ware fares had temporarily effects</td>
</tr>
<tr>
<td>The Atlantic-industrial era (AD 1800 –)</td>
<td>Development of science and technological innovations, Enormous population growth, Based on energy from fossil fuel, Societies isolate themselves from the nature</td>
<td>Greatest impact on the environment, The energy consumption is growing at a greater rate, Food production, pollution, mining, deforestation etc.</td>
</tr>
</tbody>
</table>

**Signs of nature conservation:**
- Declaring areas surrounding settlements sacred
- Allowed areas to lie "fallow"

**Signs of nature conservation:**
- Gardens being a symbol of status
- Wildlife conservation

**Signs of nature conservation:**
- Outdoor recreation
- Tourism

The average energy consumption (1 calorie = 1.163x10^{-6} kWh) per person per day for all activities illustrate human environmental impact.

Average of 3 000 calories.  
Average of 15 000 calories.  
Average of 89 000 calories in the world.  
Average of 260 000 calories in USA.
Below are examples of two cultures with conservationist behavior and another example of a culture where improved life quality increased its environmental impact.

The **Aranda hunters of Australia** (7500 BC –) are an example of early conservationists declared an area of two kilometer surrounding their settlement sacred.

**Pictures 2: Aranda Hunters**, (www.janesocenia.com)

The success of the Riverine civilizations (4000 BC – AD 100) resulted in improved health conditions and population growth. The excess energy allowed the society to pursue activities such as hunting for pleasure, garden construction, **monumental projects and warfare**.

**Pictures 3: Riverine civilizations**, (www.uncp.edu)

An emperor of the **Sung dynasty** (AD 960 – 1179) in China **prohibited the killing of kingfishers** for fashion purpose.

**Pictures 4: Preservation of kingfishers**, (www.elearning.npm.gov.tw)

### 4.2.4 Economic and political aspects of environmental problems

The vast increase in environmental problems is greatly linked with actions driven by economical interest. The pursuit of exponential economical growth is not sustainable in a long term aspect.

“**Today’s industrial infrastructure is designed to chase economic growth. It does so at the expense of other vital concerns, particularly human and ecological health, cultural and natural richness and even enjoyment and delight.**” (McDonough and Braungart 2002)

It is important to keep in mind that the pursuit of economical growth has not only been negative, it has also led to great improvements such as technical innovations, infrastructure, communication and health issues. The question of sustainable economical growth and increased life quality implies reevaluating the focus and finding new ways to achieve it in a more balanced and long term perspective.

Historically it is possible to see how environmental problems increased significantly when a new economic activity was introduced and is illustrated in Table 2: **Persistent critical environmental problems and industries that cause them**. In general the most severe and acute problems we experience today, affected by industrial activity, is food and water contamination.
Table 2: Persistent critical environmental problems and industries that cause them. (Booth 1998)

<table>
<thead>
<tr>
<th>Responsible industries, activity</th>
<th>Environmental problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal, steam technology, petroleum, motor vehicles,</td>
<td>Air pollution</td>
</tr>
<tr>
<td>electrical goods, electricity, organic chemicals</td>
<td></td>
</tr>
<tr>
<td>Motor vehicles, petroleum, highway construction, suburban development,</td>
<td>Nonpoint water pollution</td>
</tr>
<tr>
<td>agriculture, fertilizer, pesticides</td>
<td></td>
</tr>
<tr>
<td>Organic chemicals, agriculture</td>
<td>Organic toxic pollution</td>
</tr>
<tr>
<td>Agriculture, railroads, lumber, pulp and paper,</td>
<td>Destruction and fragmentation of natural areas</td>
</tr>
<tr>
<td>electricity, irrigation, advanced telecommunications,</td>
<td></td>
</tr>
<tr>
<td>microelectronics and suburban development</td>
<td></td>
</tr>
</tbody>
</table>

Based on the historical linkage between environmental problems and economic activities, Booth D.E. (1998) proposes that the same forces leading to economic growth in market capitalist economies also lead to environmental problems. Technological innovations and the drive for increased wealth result in high-growth industries that foster environmental change and are highly resilient to regulatory efforts to prevent environmental degradation. The fundamental striving of capitalistic business enterprises are the profits of growth. Backing up this growth is consumers’ strive to demonstrate material well being by acquiring higher status goods. To support this acquisition higher income is necessary and more people can afford the goods. When the masses can afford goods of higher status, it loses its high status and there is a continued pursuit for higher income to afford more rare and expensive goods. Research made in prosperous countries show that happiness do not rely on absolute income levels, but on the income level relative to the rest of the society. This implies that there is a progressively hunt for higher relative status for all.

Research looking on the relationship between income and life satisfaction on a global scale shows that increase in income improves life satisfaction up to a certain level, about $10,000 per person per year, but after this level increased income to not result in a higher degree of life satisfaction. This statement indicates that money is important but only to cover the basic needs and correlates with Maslow’s hierarchy of needs. (www.worldresourcesforum.org) The lowest levels of Maslow’s pyramid are largely reached by monetary means, but to climb higher in the pyramid money is not the only factor to achieve the higher levels. With a basic level of income one can focus on other issues than physiological and safety issues.

Since the constant aspiration of economical growth is the essence of environmental problems, it is necessary to develop a new economic vision that is rooted in a wider view of human values and ethics. The alternative vision suggested by Booth is “a steady-state economy, one with the capacity not only to satisfy real human needs, but to preserve the global environment and its full diversity of forms of life.” A steady-state economy does not necessarily mean zero economic growth, as long as the focus lies in productivity of environmental resources rather than in productivity of labor. Unfortunately the developed contries are the main barriers to economical steady-state strategies, because of their dependency of constant economical growth. (Booth 1998)

The path towards a steady-state economy is a complex issue to be addressed, but it is better to do the transition through a planned process to avoid unnecessary pain of economic and social disruption if waiting until an extreme crisis occurs. (Booth 1998)
5. Sustainable architecture

“We shape our buildings; thereafter they shape us.” Winston Churchill

Sustainable architecture is about meeting the environmental, cultural, social and economical needs of today without compromising the ability of future generations to fulfill their own needs. This chapter answers the objectives presented in Chapter 3. Its purpose is to describe the benefits, current trends and visions, barriers and tools for sustainable architecture.

Hawken (2000) is questioning how to achieve sustainable architecture, now that there are six billion individuals on the earth. It is important to find ways to use our natural resources far more efficiently, to build zero-emission houses, to design structures that can be reincorporated into earth harmlessly and endlessly and to metabolize energy and water so that the sky and land improve rather than erode. (Earth Pledge Foundation 2000)

McDonough and Braungart (2002) suggest a new design assignment for sustainable architecture. Instead of fine-tuning the existing destructive framework, architects should set out to create buildings that act like trees, producing more energy than they consume and purify their own water on site. One could imagine that factories should produce drinking water and no waste instead of polluting the earth. In addition to striving to design buildings that benefit the ecosystem, sustainable architecture is about collecting and purifying water, using sunshine, wind, water and earth to regulate indoor climate and provide electricity, design for easy remodeling in disassembling to use the building and building material for a long period of time. Orr (2006) adds the following basic principles to describe sustainable architecture:

- Preserve diversity
- Account for all costs
- Eliminate waste
- Solve for pattern
- Protect human dignity
- Leave wide margins for error, malfeasance and ignorance

Supporting a healthy ecosystem is one of the key elements of sustainable architecture, but Williamson, Radford and Bennetts (2003) find that social and cultural diversity, the well-being, health and safety of the occupants and the economic performance are other important elements. Social and cultural diversity is a significant component of sustainable architecture, because variation of human societies is the source for adaptation and innovation.

An example of the role of architecture in preserving culture is the rebuilding after an earthquake in 1956 in a Greek village on Santorini. Discussion with the local people led to that the new houses kept the scale and shape of the original buildings. In later years the village has gone through a new transformation, the shift of its major income source from fishing and agriculture to tourism, but still there is a continued pressure on restoring and building new buildings in the original style. Many of the buildings are now second homes of Athenians or rented to tourists, but the architecture supports a sense of continuity of the culture.

There are other cultures that are sustained by architecture, for example the non-geographical culture of international business groups. Their desire to reflect their values and ambitions are shown in the architecture, which is much the same throughout the world. In that manner international corporate buildings supports to preserve the culture of international business. (Williamson, Radford and Bennetts 2003)

The goal of sustainable architecture is to take care of the health, well-being and safety of the occupants and neighbors. Thus when designing a building it is very important to evaluate issues such as safety against structural collapse, long-term health of occupants and passers-by, the satisfaction of the building, comfort and protecting physical property within and around a building. (Williamson, Radford and Bennetts 2003)
In a capitalist society with marked-based economies that are dependent on capital accumulation, economically sustainable architecture must show a positive benefit/cost ratio. Those environmental projects that do not threaten the structure and interests of industrial capitalism usually are the ones that succeed. (Williamson, Radford and Bennetts 2003)

There is not a straightforward answer to what makes architecture sustainable. A building stands for a long period of time, often through many generations. How it looks, what it is used for may change over time. The projects are not always the same, the size, the site, the program, its functions, its statement etc. Sometimes it is a new construction and other times it is a renovation project. Sometimes it is a small private home set in the countryside, other times a big commercial building in the middle of a busy city centre. There are many aspects to considerate, when the architect designs a sustainable building.

Jason Frederick McLennan, Director, Elements, a division of BNIM Architects, describes the future of sustainable architecture a future of living buildings. Like their flowering counterparts, living buildings operate from seven simple principles. The envision of “living buildings” is that they will: (Earth Pledge Foundation 2000)

- Harvest all their own water and energy needs on site.
- Be adapted specifically to site and climates and evolve as conditions change.
- Operate pollution-free and generate no wastes that aren’t useful for some other process in the building or immediate environment.
- Promote the health and well-being of all inhabitants, as a healthy ecosystem does.
- Be comprised of integrated systems that maximize efficiency and comfort.
- Improve the health and diversity of the local ecosystem rather than degrade it.
- Be beautiful and inspire us to dream.

It is important that sustainability measures in building does not complicate or impose higher demands on the occupants. It is better to seek to improve and simplify life of the occupants when implementing environmental measures.
5.1 Benefits of sustainable architecture

“Every design ought to be Sustainable design, meaning something people refuse to trash” Satyendra Pakhale - cultural nomad and designer

The benefits of sustainable architecture are not always clear in the first stages of its life cycle, but become very obvious in a long term perspective. The table below summarizes the benefits of sustainable architecture.

Table 3: Benefits of green architecture. (U.S. Green Building Council, www.usgbc.org)

Quality of life could be measured by Maslow’s hierarchy of needs (See 4.2.4 Picture 5: Maslow’s Hierarchy). Increased quality of life is reached when moving higher up in the pyramid. It is reasonable that countries that are higher on the hierarchy of needs have higher capacity for sustainable development and the countries that struggle with issues in the lower parts of the hierarchy are less concerned with sustainable development. This suggests that countries with higher sustainable development capacity should act on a global level by including and supporting the countries with lower capacity.

5.2 Example of environmental buildings

Examples of environmental buildings may stretch from low-density residential developments built horizontally and integrated in the landscape to vertical skyscrapers where the average area per person is reduced and built with the latest technologies to decrease environmental impact.

“It is difficult to find good examples of big buildings that are sustainable. So far it is more common to build sustainable residence rather than skyscrapers, because often environmentally conscious individuals use money on sustainable homes and it is easier to build small homes that are environmentally friendly. Thus there are more good examples of smaller sustainable buildings, such as small wooded houses.” Rune Grasdal, Snohetta AS

"Environmental buildings must be of good architectural quality to be inspirational.” Mari Bergset, Snohetta AS

Following is a variety of environmental buildings standing today or due to be completed within a couple of years. Let the good features be inspirational and furthermore strive to enhance the amount of beautiful environmental architecture:
Bank of America

Bank of America in central New York designed by Cook Fox architects, completed in the end of 2008, is granted LEED Platinum certification. It has a system for collecting and recycling rainwater and wastewater. There is a thermal storage system in the basement, which at night uses surplus energy to freeze water to keep the building cool in summer.

(www.floornature.com)

Moscow City Tower

Moscow City Tower designed by Foster&Partners’ due to be completed by 2012. Space is used consciously to create an energy cycle, by using the heat created in the offices in winter and cooling by the soil in summer that leads the hot air through the building. The positioning of the building is oriented to maximize the use of natural light and building contains several hanging gardens.

(www.floornature.com)

The Sky Village

The Sky Village for Copenhagen-Rodrove in Denmark designed by MVRVD combines single family homes and a skyscraper in a vertical village. It is an innovative prefabricated system that can be completely dismantled, replicated and adapted to different sites and requirements. Its sustainable characteristics is flexibility, latest environmental technologies, a greywater circuit, 40% recycled concrete in the foundation and an energy producing devices on the facade.

(www.contemporist.com)

5.3 Trends and prospects

“Sometimes I see that the result of a green building is a combination of environmental material with glossy design, uncritical use of glass, expensive and bad technical solutions.” Aina Borealis Arkitekter AS

“Some houses look like it has been overgrown by vegetation. It almost looks like ruins or 18th century romantic housing style, even if it is skyscrapers.” Mari Bergset, Snohetta AS

The current trends within sustainable architecture are observed to focus on the following factors.
- Passive and active houses
- Green walls and roofs.
- Technical solutions
- Natural ventilation
- Double facades
- Massive wood construction
- Natural material
- Norwegian wood


5.3.1 Prospects

In cooperation with the architectural organizations the following thoughts represents the prospects within sustainable architecture.

- More conscious contractors and customers
- More financial support from the government for environmental solutions
- New construction regulations
- Sustainability is naturally integrated with architecture and the focus is on good architecture
- Landscape planning, interior design and architecture is more integrated
- Holistic solutions. All external experts are included from the start of the projects
- More focus on the life cycle of buildings
- More sustainability subjects in Architecture schools
- Easier to get information about products, what it contains, where and how it is produced
- Companies with environmental focus will be attractive employers and increase job opportunities.
- New technical solutions
- Use technology from other business areas (e.g. the oil business)
- "Big scale" solutions
- Mass production of façade elements with sun cells panels integrated
- Conscious placement of windows, in balance with the need for light and fresh air
- Recycled material
- Thicker walls

5.4 Barriers of sustainable architecture

When developing sustainable architecture there are several prohibiting factors that may occur. Ellen van Bueren (2001) describes a set of barriers to the implementation of sustainable building measures:

1. Financial
2. Legal and administrative
3. Knowledge
4. Image

5.4.1 Financial

The first barrier is the financial aspects, because products and processes for sustainable buildings are often more expensive than for the traditional buildings. Ellen van Bueren (2001), explains that “the structured and chain character of the interdependencies is not helping either, it results in an asynchronic allocation of costs and benefits of sustainable building measures”. For instance, energy saving measures can imply higher construction costs for the builder and profits of the saving measure will first arise when the building is in use. The return on investments of sustainable building measures often depends on the behavior of the user of the building which is often not known in advance.

5.4.2 Legal and administrative

The second barrier is according to Ellen van Bueren (2001) the legal and administrative aspects. Building regulations liability may slow down or prohibit the use of new innovations and products.

5.4.3 Knowledge

The third barrier occurs when there is a lack of knowledge. Participants of a sustainable architecture project may often be unfamiliar with the opportunities and available measures. They might be uncertain on how to organize and manage projects with a broad range of collaboration throughout the whole project and how to implement the new solutions. (Ellen van Bueren 2001)

5.4.4 Image

The fourth barrier is preconceived ideas and image. Ellen van Bueren (2001) express that some consider sustainable buildings to be an ideological issue, reserved for “believers”. Organizations often do not want to be considered as radical ecologists, for whom only a niche market exists. To inspire people to be more open for investing in sustainable buildings, it is important to develop a clear image, not necessarily a traditional one, explain what and how it is done, what the financial and sustainability costs and benefits are.

5.5 Tools for sustainable architecture

There are tools and ways of thinking to help designing sustainable architecture. Among those are understanding the life cycle of a building, Cradle to Cradle, Biomimicry and learning from earlier civilizations, learning from other business and knowledge areas and so on.

5.2.1 The life cycle of a building

There are several systems for evaluating the environmental performance of a building. Among some are the Leadership in Energy and Environmental Design (LEED), Sustainable Building Tool (SBTool) and Økoprofil. These are of varying quality and eligibility for Norwegian conditions. LEED is a certifications system developed for
conditions in USA and SBTool is an internationally designed tool to assess the environmental and sustainability performance of buildings. The sustainability aspect of SBTool means that social and economic considerations and urban planning issues are included. Both LEED and SBTool consider the whole project and the whole life cycle of the building. In contrast to Økoprofil, a Norwegian developed tool that only assesses the environmental aspects of existing buildings. (NAL, www.arkitektur.no)

For further information on the three systems see Appendix 8 LEED, Appendix 9 SBTool and Appendix 10 Økoprofil.

The following figure is inspired by these systems and tools to illustrate the environmental impact of a building in a life cycle aspect:

Figure 3: The life cycle of a building. Illustration by Haug.

5.2.1.1 Planning and designing

“Designing for the life cycle of a building means balancing the present requirements against the uncertainty of future possible requirements.” (Williamson, Radford and Bennetts 2003)

The major decisions are made at the planning and designing stage and they will affect the outcomes and possibilities in the later stages of a building’s lifecycle. Thus choosing and planning a sustainable site is very important. A sustainable site involves providing the residents with easy access to key services and transit, it should fit into the surrounding neighborhood and work with natural features to provide safe play spaces, shade the building and naturally control storm water runoff. To minimize the physical footprint it is valuable to design a compact building and parking lot layouts and take care of the biodiversity in the area.

The degree of environmental quality depends on how much the aspects in Table 4 are considered in all stages of the lifecycle of a building. The points in each stages refer not only to the building itself but also the companies that perform the stages. For example in the planning stage, it refers to how the architect company proceed with the daily work in the design process and to inspire and prioritize contractors, sub-contractors, external experts, suppliers, delivery services etc that do the same.
Table 4: Environmental aspects through the life cycle. (www.greenhome.org and Williamson, Radford and Bennetts 2003)

<table>
<thead>
<tr>
<th>Planning</th>
<th>Construction</th>
<th>In use and maintenance</th>
<th>Rehabilitation/Reconstruction</th>
</tr>
</thead>
</table>
| - Choose and plan sustainable sites  
  - Make good decisions to avoid negative impact in the later stages  
  - Smart innovation and design  
  - Operations in design offices  
  - Transportation  
  - Involve residents and community members  
  - Education and awareness | - Noise, visual impact  
  - Impact on atmosphere  
  - Energy and resource efficiency  
  - Non-toxic, recycled-content and pre-fabricated products  
  - Origin and processing of material  
  - Reduce, reuse, and recycle resources.  
  - Transportation  
  - Operations in design offices  
  - Operations on site  
  - Involve residents and community members  
  - Protect biodiversity | - Noise, shading, wind effects and visual impact  
  - Energy and resource efficiency  
  - Use non-toxic, recycled-content and pre-fabricated products  
  - Reduce, reuse, and recycle resources  
  - Protect biodiversity  
  - Well-designed ventilation and moisture control  
  - Distinctive and attractive design inspire to care for their homes, their community, and the environment  
  - Inspire to change cultural demands for indoor temperature levels  
  - Involve residents and community members and support the feeling of community | - Flexibility to increase lifespan  
  - Use non-toxic materials and finishes  
  - Use recycled-content and pre-fabricated products  
  - Reduce, reuse, and recycle resources.  
  - Inspire to change the culture of consumerism |

- Flexibility to increase lifespan  
  - Use non-toxic materials and finishes  
  - Use recycled-content and pre-fabricated products  
  - Reduce, reuse, and recycle resources.  
  - Inspire to change the culture of consumerism
5.2.2 Cradle to Cradle

“I was tired of working hard to be less bad. I wanted to be involved in making buildings, even products, with completely positive intentions.” William McDonough

“Cradle to Cradle” is a mindset when designing, providing an opportunity for intelligent innovation and sustainable products and productions. Unlike the common way of designing today, called “Cradle to Grave”, the main focus is efficiency. In addition, when the product is not useful anymore, is placed out of sight on landfills. (www.norskdesign.no)

The architect William McDonough and the chemist Michael Braungart’s book *Cradle to Cradle* emphasize a transformation of human industry through ecologically intelligent design. They see the potential to change it from an industrial system that "takes, makes and wastes" into a creator of “goods and services that generate ecological, social and economic value.” Parallel to our growing knowledge about the living earth and how we affect it, design can reflect this new spirit. (www.mcdonough.com)

The intelligence of the nature is that it does not produce waste, in nature waste equals food. Architects should eliminate the concept of waste and design from the very beginning that waste does not exist. Buildings should function and provide the same benefits as trees. They blossom or make fruits. Some of them germinate and grow. The flowers, fruits and leaves that fall to the ground and do not produce a new tree are not waste. They decompose and contribute to improve the ecosystem around the tree. Designing by the intelligence of nature means that the valuable nutrients contained in the materials shape and determined the design instead of just function. (McDonough and Braungart 2002) A designer with a mindset of “Cradle to Cradle” can create products, industrial systems, buildings and regional plans that allow nature and commerce to fruitfully co-exist. (www.mcdonough.com)

The value of “Cradle to Cradle”, is designing products and systems that continue being a resource to future generations. In order to create a future where there is room for growth and consumption that provides environmental, economical and social profit. (www.norskdesign.no)

5.2.3 Biomimicry

“Those who are inspired by a model other than Nature, a mistress above all masters, are laboring in vain.” Leonardo da Vinci

Biomimicry is innovation inspired by nature. Benyus J.M. urges, in her book *Biomimicry*, scientists, designers and engineers to study and mimic nature’s best solutions. The Earth has been “designing” for about 4,5 billion years (www.wikipedia.org), thus it is safe to say that there are many great designs to learn from the nature. Learning from nature provides the potential to change the way we grow food, make materials, harness energy, heal ourselves, store information and conduct business. A world based on biomimicry, manufacturing would be in the same way as animals and plants do, use sun and simple compounds to produce totally biodegradable fibers, ceramics, plastics and chemicals. For instance we could develop farms inspired by prairies, which are self-fertilizing and pest-resistant. Consult animals and insects, to find what medicine and plants are good for healing, who have used them for a long time be healthy and nourished. “Solar cells copied from leaves, steely fibers woven spider-style, shatterproof ceramics drawn from mother-of-pearl, cancer cures compliments of chimpanzees, perennial grains inspired by tall grass, computers that signals like cells and a close-loop economy that takes its lessons from redwood, coral reefs and oak-buckey forests.” (Benyus 2002) There are already several interesting design developed inspired by nature. A list of some of them is presented below.
Velcro

The most famous example of biomimicry was the invention of Velcro brand fasteners. Invented in 1941 by Swiss engineer George de Mestral, who took the idea from the burrs under the microscope and noticed the tiny hooks on the end of the burr's spines that caught anything with a loop - such as clothing, hair or animal fur.

Passive Cooling

Mimicking the way that tower-building termites in Africa construct their mounds to maintain a constant temperature, to design passive cooling in constructions. The insects do this by constantly opening and closing vents throughout the mound to manage convection currents of air - cooler air is drawn in from open lower sections while hot air escapes through chimneys. Buildings with this design are consuming less than 10% of the energy used in similar sized conventional buildings.

Gecko Tape

Ever wanted to walk up walls or across ceilings? Gecko Tape may be the way to do it. The tape is a material covered with nanoscopic hairs that mimic those found on the feet of gecko lizards. These millions of tiny, flexible hairs exert van der Waals forces that provide a powerful adhesive effect.

Whale power Wind Turbines

Inspired by the flippers humpback whales use to enable their surprising agility in the water, WhalePower has developed turbine blades with bumps called tubercles on the leading edge that promise greater efficiency in wind turbines, hydroelectric turbines, irrigation pumps and ventilation fans. Compared to smooth surface fins, the bumpy humpback ones have 32% less drag and an 8% increased lift in their movement through air or water. Using such blades to catch the wind could provide a 20% increase in efficiency.

The Lotus Effect

The Lotus Effect or "superhydrophobicity," is a self cleaning effect. It occurs because the surface of lotus leaves is bumpy, and this causes water to bead as well as to pick up surface contaminants in the process. The water rolls off, taking the contaminants with it. Researchers have developed ways to chemically treat the surface of plastics and metal to evoke the same effect.
Self Healing Plastic

Inspired by the human skin’s ability to self-heal, Self-healing Plastics have been developed. It is made of hollow fibers filled with epoxy resin that is released if the fibers suffer serious stresses and cracks. This creates a ‘scab’ nearly as strong as the original material. Such self-healing materials could be used to make planes, cars and even spacecraft that will be lighter, more fuel efficient, and safer.

The Golden Streamlining Principle

The Golden Streamlining Principle is based on such beautiful and recurring natural designs as the Fibonacci sequence, logarithmic spirals and the Golden Ratio. A company has been developing air and fluid movement technologies.

Artificial Photosynthesis

Artificial Photosynthesis aims to reproduce the process of how green plants use chlorophyll to convert sunlight, water and carbon dioxide into carbohydrates and oxygen. It is envisioned as a means of using sunlight to split water into hydrogen and oxygen for use as a clean fuel for vehicles as well as a way to use excess carbon dioxide in the atmosphere. The process could make hydrogen fuel cells an efficient, self-recharging and less expensive way to create and store energy applicable in home and industrial systems.

Bionic Car

Based on the shape of the tropical boxfish, it has been developed a new concept car called the Bionic Car. The design achieved an aerodynamic ideal that boasts 20% less fuel consumption and as much as an 80% reduction in nitrogen oxide emissions.

Morphing Aircraft Wings

Inspired by birds and fishes, scientists have developed Morphing Airplane Wings that change shape depending on the speed and duration of flight. Different birds have differently shaped wings useful for the speeds at which they fly, as well as for sustaining flight speeds over long distances using the least amount of energy. The wings are expected to conserve fuel and enable faster flights over longer distances.

Friction-Reducing Sharkskin

Inspired by the ability of shark's skin to reduce drag by manipulating the boundary layer flow as the fish swims, researchers are developing coatings for ship's hulls, submarines, aircraft fuselage, and even swimwear for humans.
Diatomaceous Nanotech

Genetic engineering of the tiny, single-celled algae known as diatoms in order to mass produce silicon-based nanodevices and nanotubes for specific uses. Living diatoms can manufacture working valves of various shapes and sizes that can be used in nanodevices to deliver drugs to specific targets in the body, as chemostats in chemical engineering applications, and in colonies as nanotubes for solar collectors and artificial photosynthetic processes.

Glow-in-the-dark protein

Glow-in-the-dark aquarium fish are an application of fluorescent proteins discovered in jellyfish. The protein can be attached to other molecules of interest so they can be followed for understanding of their functions in living organisms, very useful in medical research. For the fish, the proteins serve the purpose of simply being very cool - they come in several colors.

Insect-Inspired Autonomous Robots

Inspired by insects’ eyes with greater resolution and panoramic range for exploring places, insects’ ability to cover varied terrain, climb surfaces and provide stability, and their ability to quickly adapt to changing environments can improve the quality and mobility of robots.

Butterfly-Inspired Displays

By mimicking the way light reflects from the scales on a butterfly's wings, Mirasol Displays have been developed, to make use of the reflected light principle with an understanding of how human beings perceive that light. Using an interferometric modulator [IMOD] element in a two-plate conductive system, the display uses near-zero power whenever the displayed image is static while at the same time offering a refresh rate fast enough for video.

Pictures 13: Biomimicry. (www.brainz.org)
6. Result

This chapter presents the results from the interviews and answers the objectives in the following order:

1. Describe how the management supports the work with sustainable architecture.
2. Describe the building chain and how it can support sustainable architecture.
3. Describe the forces working against sustainable architecture.

6.1 Management and sustainable architecture

“We are architects and the essence of how we work is to test new things and be very open to see new possibilities. Thus we regard environmental issues in the same manner.” (Manager)

To describe how the management supports the work with sustainable architecture, environmental engagement, knowledge, goals, communication and change capability is mapped out at the three architectural organizations and presented below.

6.1.1 Environmental engagement and knowledge

6.1.1.1 Personal engagement

All architects interviewed (selection described in chapter 3.2 Unit of research) are personally engaged in environmental issues. When they reflect upon the general opinion in the office they describe that most find working with environmental solutions meaningful. Still they experience that some might find it restricting the creative process and thus acting with some resistance when environmental issues are brought up. Individuals with personal engagement are of great inspirational value and driving force in the daily processes at the organization. It is important to find means to ease the feeling of resistance that occurs when environmental issues are brought up. (See chapter 6.3 Prohibiting Factors for reasons why feeling of resistance occurs.)

6.1.1.2 Balanced environmental focus

All three companies do not have an explicit focus on environmental issues, but they use consultants or have an internal expert team that lead the focus. 3 out of 6 of the interviewed do not have a strong personal interest that the projects must have environmental focus, but their awareness is increasing. The rest find that their personal interest is an important driving force. Environmental issues should have a natural and equally balanced part of the projects as other important issues like aesthetics, economics etc.

6.1.1.3 Environmental education and knowledge

The architects explain that environmental issues (see chapter 5 Sustainable Architecture for description of environmental issues within architecture) were not a significant part of their education. Aspects related to environmental issues were brought up in other subjects. In general it was more focus on following the regulations and good technical solutions to prevent damages in the building, than environmental subjects. If an architect student wanted to learn more about environmental issues, the option was a master’s degree in environmental project planning. Landscape architects go through more subjects related to environmental issues, but not explicit focus on the relationship between sustainability and landscaping. The schools today have more focus on environmental subjects, but it is only provided as optional courses. Few students prioritize to choose environmental subjects since there are a lot of other subjects that are more popular and there are not that many occasions for optional courses.

“Strict guiding rules do not work, because they put too many restraints on the creative process. So I think it is important to avoid all these pre-accepted solutions, and think on your own. And to be able to think on your own you have to understand the whole picture” (Manager)
Environmental issues are not a natural and explicit part of architect’s education, so the management must provide the necessary support, such as external experts, courses and manage the great amount of knowledge to understand the whole picture.

6.1.2 Environmental goals and communication

Two of the companies have formulated environmental goals, such as using public transport or bicycle, serving ecological food in the cantina, reducing and recycling office material, increasing competence within environmental issues and gaining experience with environmental projects. The third company does not have any specific environmental goals.

6.1.2.1 Action plans and mandates

One of the companies develop action plans each year and in the long-term perspective they are developing strategy documents for the environmental aspects, in order to make it more concrete, clearer and thus more binding for the company. There is a need to develop more formalized mandates at the board level. Two of the companies do not have a specific action plan developed, but let individuals have responsibility of different environmental areas and serves as internal experts.

6.1.2.2 Short term actions raise environmental consciousness

The companies increase the overall environmental awareness and understanding of the goals and action plans through short term environmental implementations and actions. Such as recycling paper, promoting the use of bicycles and public transportation, ecological food in cantina, use of external experts and arranging internal and external seminars. The short term actions are visible early in the change process and encourage the staff to be more environmentally conscious in the daily life which then in turn affect that it is natural to focus on environmentally solutions in the projects. In addition it is a statement from the management that it is important to take environmental friendly actions.

6.1.2.3 Learning by doing and promote successful environmental architecture

The companies experience that “learning by doing” through projects is very valuable and spreading the new established knowledge to the rest of the organization. The best way to promote environmental architecture is by inspiring with environmental architecture that is also aesthetical and well produced. It shows that environmental aspects are not necessarily a restraining factor in the creative process.

“It is important to learn through the project. You learn much more about environmental issues by working with it in a project. When you then show the project to the rest of the office, they will see that it is possible to create great architecture at the same time as it is an environmental building. It is the best way to communicate it. It is important to have good projects and builders who are committed to the environment.” (Middle manager)

6.1.2.4 Initiate projects with a broad approach

It is important to include environmental aspects from the beginning as well as other important aspects relevant to the goals of the project. Including all aspects from the beginning may impose a slower start of the process, but the result and the total time of the project will be better.

“The environment is something that we want to include from the start, not something that you can hook on at the end. It is important that there will be resources to work with the environment from the beginning. In some project there is not enough time to figure out things and do a lot of research, thus it is necessary that the team have the right knowledge.” (Middle manager)

6.1.2.5 Communication

Environmental issues are communicated through internal experts, teams and engaged individuals and external experts, through arranging internal and attending external courses and seminars. Certifying the organization by the
Norwegian certification system “Miljøfyrtårnet” (3rd party audit), using the web page and adding a green color to the logo is a way of communicating the organizations environmental focus.

“I am used to cooperate with external experts. We are regarded them as an important support in the projects, who provides the knowledge that we do not have internally. It both enhances the quality of the project and raising and widening the knowledge base of the employees.” (Middle manager)

"The different teams at the office hold meetings and present the projects they are working with and have finished, thus spreading knowledge and awareness. In addition, we have “Value-days” where everything from environmental issues to ethics is brought up.” (Middle manager)

6.1.2.6 Individual responsibility

Necessary information is spread through email communication or through the internal environmental team. One of the organizations do not have any specific communication form, every employee must stay updated on environmental issues.

6.1.2.7 Let the process take it’s time and develop naturally

The positive side of letting the process take it’s time, is that it becomes a natural part of the organization.

The management do not believe that it is good to force the employees to become environmentally committed. It is better that the management show personal commitment and let it evolve naturally among the employees. One of the organizations let the environmental team find, process, sort out and spread the information.

6.1.2.8 Critique to the environmental goals

Generally there are some at the companies that find that the environmental goals “could have been clearer,” (Architect). "I do not know if I am the right to answer that (what the environmental goal is), generally, we will be best in everything we do. That ambition also involves doing our best on environmental issues.” (Middle manager)

Others find the organization’s environmental visions to be “general humbug.” (Architect)

6.1.3 Change capability

The architect companies scored high on the questions regarding their change capability. The employee’s experiences match the theories’ indications of what makes an organization’s change capability high. They find that compared to other architect companies, their companies are better at facing changes.

“Changes are happening all the time. The architect business is never standing still. Every project is a new challenge.” (Manager)

The companies highlight the following aspects as important qualities when facing changes:

6.1.3.1 Open and flexible company structure

Two of the companies have a rather flat structure and the third one is not that flat but seeks to maintain an open atmosphere, by having autonomic project leaders.

“The atmosphere is very open and a feeling of freedom and respect is quite noticeable. This manner of organizing helps the company to be flexible.” (Architect)

All three companies have open internal borders.

“Yes, open internal borders are a part of our philosophy and are illustrated by the organization chart, consisting of many dots with semi chaotic lines linking them.” (Manager) This philosophy is also manifested in the way all employees work together in an open landscape which encourages communication across sections and levels.
We have open internal borders and it is easy to get and share information. Cooperation across of projects is very common, but the areas of responsibility are clear. (Manager)

6.1.3.2 Cooperation with external experts
At all three companies “it is common to use external experts.” (Manager)

6.1.3.3 Encourage development to happen in all departments
At the three companies development is encouraged to happen in all departments. The experience is that it is valuable to give implementations time to happen alongside the daily processes and to create the opportunity to give feedback and contributions from the employees. At all three companies the staff should seek the answers themselves.

"My experience of implementing something that is too structured with quite rigid frames within a short time frame is very likely to not be received well. It is better to give it some time and create openings for things to change along the way and make it possible to get input and contribution from employees." (Manager)

6.1.3.4 Allow mistakes to happen
It is allowed to make mistakes at all three companies.

"Yes, it is accepted. If someone makes a mistake, no one makes fun of it.” (Architect)

"Yes, if you do not make mistakes, you probably do very little. But you should rarely make the same mistakes again.” (Manager)

6.1.3.5 Avoid unnecessary hidden laws
The employees do not experience that there are any unnecessary and prohibiting hidden laws.

“No, I do not think there are many hidden laws here. It is much less compared to where I worked before. Here you are given much more space to be who you are. I use very little energy on hidden factors and obstacles. People are very solution-oriented here, and use very little energy on small interpersonal disagreements. I think that if you have a need for clear structures around you, you can become quite frustrated, because there is very little of that here. There are little of both said and unsaid structures, so one must only find one’s place. If one is not comfortable with that it can be quite frustrating. I think most of the people here are the type of people who like it that way.” (Architect)

6.1.3.6 Positive atmosphere and feeling of community
The atmosphere is generally positive even if people might experience the change to be stressing. The companies have a strong feeling of community and they support each other through the change.

“It is though work, you need to sharpen up and you have to work really hard. There is a strong community feeling here. I think people are very happy in their jobs here. The mood is positive. I think that an office like ours is very resistant. There is a great amount of creativity and knowledge that is gathered here.” (Middle manager)

6.1.3.7 Strive to be unique
It is important for two of the companies to be unique in the market. The third does not have it as their priority.

“People expect that we will come with something special and unique. Since we are regarded upon as being a spearhead within architecture, we often get many exciting projects. Thus the type of people who wish to work with such types of projects wants to work in our company. When you have a creative environment that people want to be a part of, it is a positive spiral. Our exhibition is called the Research Laboratory, it is obvious that development and research of new solutions are a major part of the architecture that we have done.” (Middle manager)
6.1.3.8 High tempo and stress

At all three companies there is a high tempo and when it is over a long period of time some get stressed but generally a positive type of stress. Positive stress occurs when the challenge is perceived as familiar, safe, short term and within one’s coping ability. It increases the performance level because of it has a motivating and focusing effect.

“In general, it is a high pace. It is not necessarily stressful, because it is pleasurable. There have probably been some here who are working too much and are told to go home. Since it is project-based work we always have deadlines to follow, it can be quite tiring.” (Middle manager)

“The stress level is of course very high the day before a project delivery. The high stress level occurs in cycles. There is also a sort of good-stress, not negative stress. Positive stress occurs when you are enjoying the work of achieving good results.” (Manager)

“You experience high speed and low stress when you feel that you have control. Generally, I think people thrive very well here.” (Architect)

6.1.3.9 Keep employees updated on status

The employees get feedback on the company’s status on regular staff meeting.

“We get feedback on the Monday meetings. I think the management is good at communicating such information.” (Architect)

“When everyone gets continually updated on the status, people get a very strong relationship with the company. We do not have two owners who demand to have their names on everything. Do you work here you are one of us, it is the project team who is the owner and responsible for the project. In addition, the way we run our projects, by keeping everyone involved in the meetings and the development of the project, means that everybody gets a very strong ownership of the final product, even if the customer often gets shock when we come with 7-8 people at the first introduction meeting. It is quite unusual to do it that way. But I experience that more and more people see the value in that.” (Manager)

6.1.3.10 The frequency of new solutions in projects

It seems like it is not that often that new solutions are included in the projects, because it is difficult to get approval from the customer.

“I do not know.” (Architect)

“It is difficult to get approval for new solutions. For example to have natural ventilation in an office space is often hard to get the contractor’s approval, which results in a compromising solution. We experienced that in a recent project, they were quite skeptical about solutions that were not tested in Norway before. It did not help to say that in Denmark there have been built 20 office buildings with natural ventilation the last 2 years, and they have similar climates.” (Manager)

6.2 Building chain and sustainable architecture

The building project consists of stages that start with the idea of a construction to the physical final construction.

The designing part (the green colored stages in Figure 4) of a building project may vary depending on whether it is a project or competition and even depending on what country it is done in. The process of a competition is somewhat separate, here the main focus and energy goes to develop the idea and concept really far. A common project process consists of stages that get increasingly detailed throughout the process towards the construction stage.

A common building process in Norway may look as illustrated below:
According to Tore I Haugen (1999), the objective in the building process is to produce good quality buildings and constructions - architectural, functional, technical, environmental and operational - within agreed time and costs. The most important factors in achieving it in the most efficient way without unnecessary use of resources are:

- good competence in the whole value chain
- co-operation between all participants involved
- well defined responsibilities for all participants
- project management focusing on lean production and minimization of bureaucracy and formalism

### 6.2.1 Cooperation

How is the cooperation throughout the process today? It is described by the architect firms interviewed, that the architect traditionally works quite separate from advisory engineers and external experts in the first stages of the development process, the “Sketching & concept” and “Pre-project” stages. These stages are where the leading concept is developed and the specifications are formed. Thus the solutions suggested by the advisory engineers and external experts must fit within the frames that are drawn by the architect. This means that the success of the project is very dependent on a good framework. Otherwise the result may not be as good as it potentially could be.

The traditional outlook of who works at what stage and how the cooperation is can be illustrated by the following:

![Figure 5: Who traditionally work at the different stages of the development and construction process. Illustrated by Haug.](image)

The architects firms experience that it is beneficial to work as broad as possible from day 1 of the project. Include all advisory personnel, such as engineers, landscape architects, biologists, artists, acoustic experts, suppliers etc dependent on type of project. When working with a broad set of expertise in the beginning of the project the architecture may end up more interesting and beautiful in addition to be more sustainable and holistic.

“Working like this may seem more expensive and time consuming in the beginning, but usually the total time of the project is shorter because you avoid big setbacks. A well and broad developed concept result in a more cost efficient construction phase, operation and maintenance and minimize the costs of major changes later in the project.” (Manager)

The optimal outlook of who works at what stage and how the cooperation is can be illustrated by the following:
6.2.2 Interprofessional communication

Interprofessional communication is described by Øvretveit, Mathias & Thompson (1997, p2) as: “how two or more people from different professions communicate and cooperate to achieve a common goal”.

In the “Sketching & Concept”, “Pre-project” and “Detail project” stages it is normal to arrange workshops where all professionals is gathered to exchange knowledge and develop the project. The workshop may last for two days followed by a period where all participants work on their own before they meet again. Sometimes the workshops consist of 20-30 people of different professional background, personalities and communication skills. This can be quite demanding on the team and good communication is essential to achieve successful meetings. Successful interprofessional teams usually continue to cooperate in new projects.

When people in the project is located far from each other video conferences is used, but the experience is that nothing beats sitting down and go through the ideas face to face.

"It is easy to communicate with other professionals, but it is difficult depending on who you talk to and what kind of company you work with. We have some consultants we work a lot with, and we are likely to do that over and over again in other projects. It is not only dependent on the organization. It is ultimately very dependent on the personal chemistry, whether the cooperation and exchange of information works well. It is best to get together and go through ideas and details face to face. Combining communication with availability and time differences are more difficult if you are on different sides of the globe. We use a lot of video conferencing. But nothing beats sitting across the table and go through the drawings together. So we have workshops where we invite all the consultants. Then it is like 20-30 external people in addition to our 20-30 employees working in a team. So there are big events that go over 2 days. Where we go through all the drawings, exchanged information and then head over to their rooms and working individually. This process repeats itself."
(Manager)

6.2.3 Network

Finding suitable external professionals to the projects is very important but may not always be easy. Professionals are often used to work with professionals within their own area and not with professionals from other areas. The knowledge an architect needs from an ecologist may be of a different type of what an ecologist is used to give. In addition maybe the ecologist is of the personal opinion that any type of building has a negative impact on the environment and may have a negative attitude to the whole project. Having a big network is therefore essential. Building networks where communication is open and free and map who can answer what types of questions.

"It is depending on the person, thus it is hard to find the right professionals. There is a need for to establish a good network."
(Manager)

"It is important to establish networks where there is a low threshold for good communication in the early stages. It is easier when you get better acquainted with each other and then you know who have the answer to what questions. Sometimes you cooperate with an ecologist who works with conservation. They might have a really different mindset since they often work against that stuff shall be built. Usually they do not work in the construction industry. To find the experts who can help is not always easy. We in the environmental group, talk a lot about that there is a lack of a professional group, as far as we know. An optimal type of ecology consultant would be a person who is interested in ecosystem and ecology, but not to protect what we have but to produce things in a more sensible manner. We had a biologist here that we tried to ask for advice. He ended up only focusing on how many species had been wiped out in the last so and so many years."
(Architect)
6.3 Prohibiting factors

The architects experience a variety of prohibiting factors when working with environmental issues. Some of the factors may in some situation be a positive driving force. It is valuable to map out the negative forces to understand what changes is important to implement.

"Sometimes you can feel that you are putting sticks in the wheels when you bring up environmental aspects, people want mainly to focus on creating something that looks nice." (Architect)

“I think there is prestige in having an environmental building. I believe that people are ready for it.” (Architect)

6.3.1 Time

Time is a prohibiting factor when it is necessary to do extra research and create new solutions.

6.3.2 Money

Money is a prohibiting factor when environmental solutions are more expensive or there is a need for research to find new solutions. Ultimately it is dependent whether the customer wants to invest in it. In difficult financial times, the priority is to survive and not on environmental issues. But some companies find that investing in environmental projects is a way of surviving. Investment in environmental projects will often give profits in a long term perspective and might not come directly back to the investor but to the future owners or the society in general.

“Sometimes the customer does not want to pay for the investment. It does not make any difference for the contractor if we want to develop a building that use less energy. The contractor is not the one how is going to pay the electricity bill, and will not directly benefit of investing in energy saving solutions. They think that as long as tenants do not demand it, we do not bother to spend money on it. Then we try to convince them that it is not a cost but a rewarding investment. Thus often it is dependent on how well we manage to sell it, that it is not strictly an expense but also a profit.” (Manager)

6.3.3 Knowledge

The lack of knowledge or managing the overwhelming amount of knowledge might be a prohibiting factor. Usually it is safer to invest in something that one knows is working. When there is a lack of knowledge about a new solution the customer might be more skeptical. It is important to develop project processes that make use of the knowledge base and the architect’s interest for the environment. There are signs of that the environmental awareness is increasing quite rapidly.

“There’s the aspect of knowledge. We could have been even better at developing the knowledge base of our staff. Regardless whether it is necessary in the project they currently are working in. It is valuable to increase the general level of knowledge in the whole office. It is in our plans, but it is perhaps going a little too slow.” (Manager)

“There are many people who unfortunately still do not believe in environmental problems, that they are not manmade and that scientists exaggerate.” (Middle manager)

6.3.4 Client

The client’s level of commitment may be a prohibiting factor. Since they have varying level of environmental aspirations some are more reluctant to invest in environmental projects.

6.3.5 Network

The lack of a good network of external experts can be a prohibiting factor. It can be difficult to establish a network of those who both understand the building enterprise and can provide valuable information regarding environmental
solutions.

### 6.3.6 Bad examples

Environmental buildings with poor architectural quality have a counterproductive effect and thus serve as a prohibiting factor.

“There is a lack of good examples of environmental building. I think it is very important to change this fact.” (Middle manager)

### 6.3.7 Preconceptions

Preconceptions on how environmental architecture looks like, might hinder the creative process. It is necessary to believe that it is possible to create beautiful and modern environmental architecture.

### 6.3.8 Disagreement

Most people agree that it is necessary to have an environmental approach. The problem arise when people disagree and what areas to focus on and how to solve it.

### 6.3.9 Regulations

The absence of strict rules and regulations makes it easier to ignore the need of environmental architecture.

### 6.3.10 Classification tools

The lack of good classification tools is a prohibiting factor. Classification tools make it easier to evaluate the environmental performance of a building and are beneficial to raise the awareness. Improvement of a better Norwegian classification tools is under development.

### 6.3.11 Relationship with nature

The lack of contact with nature prohibits people to understand the value of taking care of the environment.

“I was on a presentation, where a Norwegian philosopher lectured at the ‘Professional days for landscape architects’. He talked about human’s relationship and the view upon nature before and now. About how today’s view on nature is prohibiting people’s ability to do what really is the appropriate thing to do. I found it quite interesting.” (Architect)

### 6.3.12 Language and phrases

Unclear language and phrases can be a prohibiting factor. It is necessary to have language and phrases that explains environmental issues in a clear manner to avoid chaos.
7. Discussion

Organization’s main goal and dependence is economical success. The mentality has been that it is measured through exponential economical growth. It is getting more apparent that it is not sustainable and that it is necessary to reevaluate the means for economical success. The organizations that evolve and adapt to sustainable thinking will be better prepared when bigger crisis occurs and tougher restrictions are implemented by governments.

Meeting future demands for sustainability and buildings impose great questions and dilemmas. With the rapid growing population in mind, is it sustainable that everyone who wishes to live in a villa can do so? It might be better to use the area more efficient and build skyscrapers and eco cities that provide similar qualities as living in a villa. The benefits can be decreased transportation needs and better area efficiency but on the other side it might increase the ecological impact on the area and decrease life quality of the habitants. Or when looking at one of the biggest social problems in modern societies – loneliness – sustainable eco cities could be its remedy.

The result from the interviews is quite consistent with the theories presented. However there are some new interesting aspects that were highlighted in the interviews. Some of them diverts from the theories. Such as the architectural organization’s experience with the necessity of letting the process of change, of incorporating environmental issues into the projects, to be flexible, take its time and give room for communication to develop naturally. On the contrary the theories of change management advise that the process should have a short time frame with a lot of momentum. I think that the reason for this divergence is that environmental issues are more complex and include the need to seek continual improvement and development. It does not have a clear finishing line like many other change processes e.g. changing from closed to open office landscape or implement new software. Implementation of environmental issues consist of many changes of different character, sometimes it is concrete changes like implementation of new software and other it is more general like changing the mindset, behavior, habits and culture. What sustainable architecture is does not have a clear and single answer. To become successful with sustainable architecture there is a need for a holistic approach, thus the implementation process needs to be holistic and flexible. There might be a risk that since the change is so complex and acquires long term flexibility it does not get the necessary focus and priority in the organization and rather becomes a burden mentally and financially.

Other interesting aspects from the interviews are in the same direction as the theories but are more concrete and valuable specifically for architectural organizations. Such as “learning by doing”, people learn more and easier by experiencing the new knowledge. Using successful environmental architecture as the source for inspiration and promotion, and to counterbalance the prohibiting factor of believing that environmental issues interferes with the creative process and reduce the quality of the architecture. Using pre-accepted solutions also impose a risk of prohibiting and reducing the quality of the architecture. It is better to think on your own in every project, which means that it is important to understand the whole picture. The holistic aspect of sustainable architecture implies the importance of initiating the projects broad, by including all participants and experts that provide valuable insight to create the best solutions. Thus also establishing a broad and qualified network and knowing who knows what, is very important and makes it more effective. Letting environmental issues be equally important and incorporated with other important issues. Which is important because an organization can not only focus on single subjects, they have to consider many aspects such as economical, quality and ethical as well as environmental issues. There is a great value to promote a feeling of community in the organization, thus everyone supports each other when facing challenging demands.

This report speaks of the value of working holistically. Thus it draws aspects from a broad specter of theoretical subjects, such as economical, psychological, social and historical theories. Further, during the observation studies and interviews at the architectural organizations the focus lied in understanding the big picture. The area of study has mainly been limited to buildings, but it might also be valuable to investigate in eco cities to provide an even broader insight. The chosen limitations have both strengths and weaknesses. The report covers a broad area and might fail to notice important insights that could be found with a more narrow scope. Further the term sustainable architecture includes many areas and sometimes it is necessary to only look at the ecological aspects of sustainability.

Further studies

My suggestions for further studies would be to look at how the management can eliminate the prohibiting factors (presented in chapter 5.4 Barriers of Sustainable Architecture and 6.3 Prohibiting Factors) and how they can balance environmental issues with other important issues, such as economical, social and ethical aspects. Further to investigate whether there are any additional valuable tools for development of sustainable architecture, look into the value of initiating projects with a broad approach and how to make it run smoothly.
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10. Appendices

Appendix 1: Interview questions

Appendix 2: Environmental management – Identify the team and overcome obstacles

Appendix 3: Change management – Eight steps to increase change capability

Appendix 4:

Appendix 5: Multiple change management techniques

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Appendix 7: Freudian-, Social-, Behavioral-, Cognitive psychology of environmental problems

Appendix 8: LEED

Appendix 9: SBTool

Appendix 10: Økoprofil
APPENDIX 1 Interview questions (Number of pages 1)

1. The Architect, the office and environmental issues:
   a. Are the architects personally engaged in environmental issues?
   b. Was environmental issues a part of their education?
   c. Are environmental issues a natural part of your job?
   d. Do they have the necessary knowledge and tools/ do they know Cradle to cradle, bio-mimicry?
   e. What is the architect’s social and environmental responsibility?

2. Management and environmental goals and visions:
   a. Do the organizations have environmental goals?
   b. Are action plans formulated to achieve the goals?
   c. How are the goals and action plans communicated?
   d. Do you agree with the visions and the actions that are made to achieve
   e. Are the visions, goals and actions linked with the individual architect? Does the individual architect get feedback on how it affects their role? How is the communication?

3. Company and change capability:
   a. How is the organization’s change capability?

According to literature on change management the following aspects illustrates the company’s change capability
   b. How is the company structure? Top-down controlled?
   c. Are the internal boarders closed or open?
   d. Cooperation with external experts? (Manufactures, engineers, biologist, etc.)
   e. Is development controlled and structured by the management? Or is it encouraged to happen in all departments?
   f. Does the management provide answers or do they support the staff to find the answers themselves?
   g. Is it allowed to make mistakes?
   h. Are there any hidden laws? To people find them unnecessary? Are they a prohibiting factor?
   i. Do they have experience with change?
   j. How is the atmosphere and attitudes towards change?
   k. Is it important to be unique?
   l. How is the work load, tempo and stress level?
   m. How do the employees know whether it is going good or bad with business?
   n. What is the distribution between the project with new solutions and known solutions?

4. How does the building chain look like? How is the communication, cooperation and network?

5. What forces do you experience work "for" and "against" sustainable architecture?
APPENDIX 2 Environmental management - Identify the team and overcome obstacles
(Number of pages 1)

Schmandt and Ward (2000) sum up nine personal skills that enable a leader to identify the right team and overcome the obstacles in record time.

1. Forget about blame – find what works.
   Focus on the solution, rather than opinions and positions, and find out what works best.

2. Build a broad and deep network of personal friendships, associations and affiliations.
   Recognize the importance of personal relationship and discover the value latent in networks.

3. Cultivate risk, ambiguity and uncertainty as sources of powerful change.
   Tolerance of productive ambiguity is important when searching for new opportunities and change.

4. Select brilliant, reliable deputies.
   This will allow the leader to maintain compliance as she stretches for the further goals that compound value throughout the organization.

5. Check your instinct against your clients’ needs.
   Know what your client needs.

6. Replicate success, using lots of small steps to clear the top.
   If the goal is to jump a 6 meters hurdle, it is better to divide it up three two meters hurdles, making the goal possible to achieve.

7. Make the future of the organization promising to everyone in it.

8. Use stories and metaphors to reinforce the goals of the organization and sense of belonging.

9. Acknowledge the importance of everyone’s role.
   The goal of the last three points is to compound the value of everyone in the organization, by making the future of the organization promising, taking everybody seriously and using “tribal” stories where the actions of the individual cohere into a meaningful message. (Schmandt and Ward 2000)
APPENDIX 3 Change management – Eight steps to increase change capability (Number of pages 3)

1. Increase Urgency

The first step is to create an atmosphere of urgency among the majority of the employees, so that they look for opportunities, problems and energize colleagues. Without urgency, large-scale change will be difficult to achieve. Normally four types of behavior prohibit change, since it prevents people from taking action:

- Complacency (a feeling of security, often while unaware of some potential danger), driven by false pride or arrogance.
- Immobilization and self-protection, driven by fear or panic.
- “You-can’t-make-me-move” deviance, driven by anger.
- Pessimistic attitude, leading to constant hesitation.

Kotter J. and Cohen D. warns to avoid creating a new vision as the first step, especially if the company is in an urging crisis. Using time and energy on discussing a new vision will only make the people unwary and more focused on saving their own position.

Here is what works to motivate action:

- Show others the need to change with a compelling object that they can actually see, touch and feel.
- Show people valid and dramatic evidence from outside the organization that demonstrates that change is required.
- Look for cheap and easy ways to reduce complacency and don’t underestimate complacency, fear and anger.

2. Build the guiding team

The second step is to put together a powerful team who is aware of the urgency and will guide their colleagues through the change. “A fragmented management team cannot do the job, and a hero CEO does not work either. There are not enough hours in the day for even the strongest executive to accomplish change single-handedly.” Thus putting together an effective guiding team is advantageous. A successful guiding team exhibits teamwork and consists of individuals with “appropriate skills, leadership capacity, organizational credibility and the connections to handle organizational change”. The team may necessarily not consist mainly of the existing senior management.

The team should possess:

- Relevant knowledge about what’s happening outside the enterprise (essential for creating vision).
- Credibility, connections and stature within the organization (essential for communicating vision).
- Valid information about the internal workings of the enterprise (essential for removing barriers that disempower people from acting on the vision).
- Formal authority and the managerial skills associated with planning, organizing and control (needed to create short-term wins).
- The leadership skills associated with vision, community, and motivation (required for nearly every aspect of the change process).

“As change progresses throughout the entire organization, additional groups are formed at lower levels. These teams help drive action within their units. Together, these groups form a kind of guiding coalition.”
It is important to have good meeting structure to pull the team together into a powerful force. Meetings of poor structure results in growing frustration and undermine trust. To avoid the risk of having meetings of wrong format it is important to stick to one topic per meeting, decide on the length and how often the meetings should be held, put some credible in charge and the person in charge for the organization or department should be a central driving force in the team.

3. Get the vision right

The third step is to produce a clear sense of direction for the change, to establish the vision for the new organization. Define the steps towards the vision. Identify what strategies are unacceptably dangerous.

Kotter J. and Cohen D. suggests the following to get the vision right:

- Articulate a vision that is so clear that it fits on one page and takes less than a minute to share.
- Articulate a vision that’s moving - such as a commitment to serve people.
- Create a bold strategy and move ahead quickly.
- Don’t assume that logical plans and budgets are enough.
- Don’t rely on overly analytical, financially based vision exercises.
- Don’t rely on visions that just slash costs. These produce anxiety and depression, but rarely change.

4. Communicate for buy-in

The fourth step is to communicate the vision and the change strategies to as many people as possible, in a way that makes them buy-in on it. To achieve this, the guiding team should avoid arguing with the reactions that occurs and rather find ways to deal with it, through addressing anxieties, accepting anger, and evoking faith in the vision.

Arranging a “Question & Answer” session can be a very effective way of communicating the change message. It must include a well-prepared presentation and encourage the employees to ask questions. The message communicated must be simple and heartfelt, not complex and technocratic. Diminishing reasons to raise fear, anger, distrust and pessimism among the employees and support feelings of relief and optimism. A successful “Q&A” session makes the employees begin to buy into the changes and they start to take steps to make change happen.

Further, according to Kotter J. and Cohen D., it is important that the guiding team shows their support to the message not only through words but with actions that are consistent with the change visions - “actions speak louder than words”.

5. Empower action

The fifth step is to empower actions by removing barriers on the path of change. Kotter J. and Cohen D. presents four possible barriers that may occur in the process of change, the boss, the system, the mind and information.

When a boss or an immediate manager does not show genuinely acceptance of the change process, the subordinate will recognize this and will not put much energy into the process. In order to overcome a reluctant boss it is necessary to have a creative approach and keep their personal aspect in mind. It is not a good solution to ignore the barrier, send the “obstacle” to a short training course or fire, demote or transfer him/her.

Typical barriers resulted by the system is bureaucracy or the more modern system of performance evaluation and reward. If the reward for achieving the goal is too little compared to the amount of energy necessary to put in or if the goal is not reached they will be evaluated badly, the system may disempower the employees. On the other hand, it can empower employees “by identifying and compensating behavior that is required by the vision”.

Some may have decided in their mind that they are not capable to go through with the change, for different reasons. “Never underestimate the power of the mind to disempower, but don’t underestimate the power of clever people to help others see the possibilities either.”
The information barrier is another important one. “Information is a source of power, and lack of information can be disempowering.” Feedback is one of the most powerful forms of information. It is important that the feedback is given in a sincere and objective way so that the person is open to the comments.

6. Create short-term wins

The sixth step is to create short-term wins that “nourish faith in the change effort, emotionally reward the hard workers, keep the critics at bay, and build momentum.”

Kotter J. and Cohen D. presses on the importance of focus. Scattered attention on too many projects may result in wins that come too late or are not visible at all. Thus, it is better to focus on few projects guarantee visible and meaningful results early in the change process.

7. Maintain momentum

The seventh step is to maintain momentum by “keeping urgency up and a feeling of false pride down; by eliminating unnecessary, exhausting and demoralizing work; and by not declaring victory prematurely.” When the easy and short-term projects are won, it is time to tackle the bigger and more difficult projects. This may be frightening, but simple courage, perseverance and structured situations to empower people with time, resources and access to achieve the goals help.

Kotter J. and Cohen D. writes that “deep into a transformation, even if urgency remains high, even if people want to take on the big problems, and even if they succeed in generating waves of change, they can still fail because of exhaustion.” To avoid getting exhausted they recommend evaluating what day-today activities that adds value and is of absolute necessity to do and thus differentiating what tasks can be put on a hold or delegated.

8. Make change stick

The last of the eight steps is to make change stick by “creating a new, supportive and strong organizational culture”. It is necessary to avoid the change being help up solely by the change team. The change must be supported by the culture in the organization. Changing the culture is hard, according to Kotter J. and Cohen D., because norms are deeply embedded in the organization and it is difficult to create new ones. It is important to introduce new employees to the culture early on, to help them become a part of the organization fast. To create an increasingly stable and solid foundation, it helps to choose people that truly reflect the new culture, when considering promotions.

(Kotter and Cohen 2002)
APPENDIX 4 Organizational Timeline: Writing the History of Your Organization  (Number of pages 2)

The objective of the Tool is to appreciate our history, trends we have experienced, as well as what the past means to us.

In an institution, it is important to create a common body of history in a participatory way. Historians accept, to a growing extent, the findings of cognitive psychology and neuro-biology. As Wolf Singer, the director of a private German research organization for brain sciences puts it: "We just perceive what we expect anyhow." That means that history, in particular the recording of oral history, is always related to the construction of reality people make in their minds. Whoever is recording the history of the organization will be selective, often over generalize, and sometimes distort information. The more views on organizational history are collected, the more people are involved in the selection of relevant issues to be interpreted and recorded, the greater the chance for successful organizational change.

Time lines are a part of an organization's history. They encourage people to tell their own stories and to compare them with those of colleagues. Overall, they help to identify trends and important events that changed the flow of the organization's history.

Worksheet for participants to be used in a workshop:

Step 1: Drawing the time line

Alone, think about events that represent notable milestones and/or turning points in your personal life, globally and in the history of your organization. Try to identify a couple of assumptions that you made at certain times of the history. There are some sheets attached that will help you to focus on important events.

Use a marker to write (or draw) your milestones on the time line which is displayed on the pinboards. Use black markers for the "facts" that happened and red markers for the "assumptions".

Step 2: Analyzing the time line

The participants form groups of 6-8 persons. Each group will analyze one of the three different time lines with the following questions:

What were important trends are noticed at different times?

What assumptions did/do people make on the future?

How did the trends and assumptions shape what happened next?

Are there important lessons for the future?

What does the personal time line say about the people working within your organization?

What does the global time line say about the position of your organization in the world and how the organization has reacted to global trends?

What does the institutional time line say about the learning processes within the organization?
PERSONAL: What you did and what happened to you?

1920 - 1990 (what happened) what did you expect to happen next?
1990 - 2000 (what happened) what did you expect to happen next?
2000 - 2010 (what happened) what did you expect to happen next?
2010 - 2020 (what do you expect to happen next)

GLOBAL TRENDS What outside influences shaped the work you are doing?

1920 - 1990 (what happened) what did you expect to happen next?
1990 - 2000 (what happened) what did you expect to happen next?
2000 - 2010 (what happened) what did you expect to happen next?
2010 - 2020 (what do you expect to happen next)

YOUR ORGANIZATION What happened in your organization?

1920 - 1990 (what happened) what did you expect to happen next?
1990 - 2000 (what happened) what did you expect to happen next?
2000 - 2010 (what happened) what did you expect to happen next?
2010 - 2020 (what do you expect to happen next)
APPENDIX 5 Change Drivers and Change Levels (Number of pages 1)

Analyze Change Drivers on Different Levels of Change

In the daily activities of an organization, the individual identifies itself on three levels. As the individual self, as part of a team or unit and as part of the organization or a larger system. In essence, sustainable change requires a transformation on all three levels. Through various learning processes, the consultant or facilitator assists the individual, unit and organization to comprehend and reflect the various aspects affecting them and to realize positive opportunities for change.

Group Exercise: Change Drivers and Change Levels (45 minutes)

Step 1: Get together in groups of 7-8. Identify a facilitator, a time keeper and a presenter. (5 minutes)

Step 2: Each group member identifies one change driver that affects them in person, their core team, or organization as a whole. Write those change drivers on paper cards and fix them at the pin board (column 1). Do not discuss these change drivers, all opinions are valid. Contradictions are appreciated! (10 minutes)

Step 3: After having finished with step one, each member of the group marks those change drivers that affect her/him personally, her/his team, or the organization as a whole. Use the sticky dots for marking those in column 2. Again, do not discuss this step. Differences are appreciated! (10 minutes)

Step 4: Discuss with the other group members, whether those change drivers affect individuals, teams, and/or the organization as a whole, and make corresponding remarks in column 3 (I= individual; T=Team; O=Organization). A change driver might affect only one of the three levels, or two, or all three. If you cannot agree, mark the respective field with a red arrow (10 minutes)

Step 5: Together as a group, identify one consequence for the organization as a result of the change driver. The facilitator writes them on a paper cards and fixes them at column 4. (10 minutes)

Step 6: Present your results in the plenary.

Example:

<table>
<thead>
<tr>
<th>Change Drivers</th>
<th>Does that driver affect you, your team, or the organization?</th>
<th>Which level is affected?</th>
<th>Consequences for the organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>New vision of central management</td>
<td>★</td>
<td>I,T,O</td>
<td>Vision has to be translated into executable actions</td>
</tr>
<tr>
<td>Pressure of society to ethical performance</td>
<td>★★</td>
<td>O,I</td>
<td>Need for int. and ext. communication strategies</td>
</tr>
<tr>
<td>Dissatisfaction of staff with new promotion rules</td>
<td>★★</td>
<td>I,O</td>
<td>Support of middle mgmt. in leadership roles</td>
</tr>
</tbody>
</table>

(www.change-management-toolbook.com)
APPENDIX 6 Agreement & Certainty Matrix (Number of pages 2)

Ralph Stacey’s Agreement & Certainty Matrix

In the last ten years, complexity science had a strong impact on the theory and practice of change facilitation. Tools like Open Space Technology, Appreciative Inquiry and others are based on the assumption that highly complex social systems like organisations follow certain generic principles and resemble other systems such as the body, colonies of ants, swarms of fish or birds, etc. Also, cybernetic models have been applied, for example for the description of systems archetypes by Peter Senge. Searching for a model that gives a simple road map for dealing with complexity, I found the model of Ralph Stacey.

As it can be seen in Figure 1, Stacey has proposed a matrix that introduces two dimensions with regards to management of organisations: Certainty and Agreement:

Certainty depends on the quality of the information base that facilitates individual and joint decisions in organisations. Rational management has tried hard to increase uncertainty by introducing tools like fishbone analysis, the Boston Matrix, customer research, etc. And, in fact there are many day-to-day decisions in management, where analytical decision making is highly successful. There are, however, many situations in which decision is made on assumptions. Depending on the number of stakeholders involved, the projected time frame, the susceptibility of the project to external influence factors, etc., projects might become very complex and it becomes impossible to realistically predict outcomes.

Modern social systems such as organisations are mainly self-organised on the base of negotiation processes. The degree of agreement among the people directly involved on what should be done ("the truth") with respect to the implementation methodology of a project is an important factor determining success.

Figure 1: Ralph Stacey’s Agreement & Certainty Matrix (modified from: Brenda Zimmerman)

1. Many simple business processes are situated at a level in which it is certain what needs to be done and people involved agree on that. Here, traditional management approaches, e.g. management by objectives apply and work well. However, leaders should always question themselves, "How do we know that we know?", "Have we assessed all the critical variables?" and "What have we done to assure that people in our organisation share a common perspective?" Often, managers are blinded by their own vision. A tool to assess different perspectives is a participatory risk analysis.

2. Very often, strategic analyses show a strategy that is most likely to lead to a better business performance. What has to be done, and what will be the outcome, is quite obvious to analysts. However, members of the organisation might not agree or, for any reason, show resistance to the planned changes. Take, for example, the implementation of company wide software platforms that facilitates management of business processes. There are hundred of examples where such projects have faced severe problems during the implementation phase. A case study how Nestlé has learned this the hard way can be found at:
So, what to do in situations characterized by certainty but disagreement and resistance? If you can't (or don't want) to fire all that are blocking your plans, there is no other way than selling your project. This takes time and resources but will save you a lot of money at the end. Of the modern Change Management approaches, Real Time Strategic Change (RTSC) is certainly one methodological framework to be applied in such situations.

3. The other extreme in which managers find themselves and their organisations is characterised by a high agreement of stakeholders - what Senge calls "shared vision", but a high degree of uncertainty. "How will our business sector evolve?", "What new technologies will be available tomorrow?", "Which political decisions will influence our future?", etc. are just some key questions that apply. This is the area of scenario design, see Scenario Analysis. Also, the current theories of Otto Scharmer (http://www.ottoscharmer.com/) provide leverage to navigate through such environments. Also, participatory approaches for defining strategies apply very well in such situations.

4. You wouldn't like to be in the manager's hot seat who faces a situation in which the future is highly uncertain and the stakeholders are far beyond any agreement. However, many political leaders are operating in exactly such an environment. In an organisation you would do everything to avoid that situation, because it is what complexity scientists call "The Edge of Chaos". The fall of the Berlin wall, one of my favorite stories that illustrate complexity, is such a story, where a system that had been stable for 40 years, collapsed in one night of freedom celebration.

5. Most contemporary management processes are situated in a field that fluctuates between the extremes that have been delineated above. Characterised by a medium to high level of uncertainty and by stakeholders with highly diversified perspectives on what should be done. Here, laws of complexity science and neurobiology apply to change in organisations, and change is the norm. In such environments, the main task of management is to facilitate the co-creation of the organisation's future, to provide room for self-organisation and to let people decide themselves about their own and their organisation's issues. I firmly believe that such strategies are the only way to lead out of the political crisis of the world, and that more and more profit and non-profit organisations will adapt management tools for co-creation, such as Open Space Technology, Appreciative Inquiry, World Café, and other tools to come.

(www.change-management-toolbook.com)
APPENDIX 7 Multiple change management techniques (Number of pages 2)

1. Emphasizing organizational memory and forgetting.

The first technique according to Meyer, C. B. and Stensaker, I. G. (2007) is to secure organizational memory, by avoiding “that new managers, perhaps with no past history in the organization, introduce changes which do not take into account the changes that have been implemented in the past and/or which dominate the focus of current change projects”. Purposefully focusing on organizational memory creates clearer linkages between past and present change projects. It can contribute in a better understanding of the outcomes of previous changes and helps the employees who express frustration if many change projects are never completed.

A way of securing organizational memory is by assuring that the new teams that are established consist of a mixture between newly recruited managers and managers that know the organizational history and culture. This method secure that new changes are anchored in the historical and cultural context of the organization while at the same time ensuring that new ideas are introduced by new managers.

Meyer, C. B. and Stensaker, I. G. (2007) have found that mastering organizational forgetting is equally important, that “those who manage multiple change processes need to simultaneously attend to organizational memory and forgetting”. Organizational forgetting implies that the managers notify the employees which routines and tasks can be left behind and forgotten. “The purpose is to avoid that new tasks are just added on to a full work load and that the individual's priority of tasks happens ad hoc and in conflict with the organization's overall goals.”

2. Thinking in the present and the future tense.

In the second technique, Meyer, C. B. and Stensaker, I. G. (2007) emphasize the importance of keeping full attention on current change projects, while simultaneously thinking about future projects. Current projects have to be followed through before letting other priorities take over. It is significant to consider how the content of new change projects relate current projects and if there are any conflicting purposes and implications, these must be explained. The managers should also be aware of the nature of the change, if the organization has gone through a series of “negative” changes, such as downsizing, it is valuable turn the focus on external matters and have more optimistic change implementations.

Managers should protect the employees from always having to think about the current and future changes by avoiding to expos the same individuals or departments for change each time and make certain that they get pockets of time where they can focus only on daily operations and on improvements in routines and practices. They should also be aware of how the employees have and are experiencing changes, they remember how they have been treated in change processes and attitudes and reactions to change are often based on previous experience with change. “If the employees are treated fairly and with respect, then they are more likely to welcome change. On the other hand, if the employees are worn out from previous processes, and have bad experiences from previous change processes, then they are not likely to be positive towards a new change process.” (Meyer and Stensaker 2007)

3. Creating flexible change routines.

The third technique highlights the balance between routines and flexibility. Routines are important for streamlining change processes over time. The routines describes cooperation with the unions, communication with employees, whom to involve and etc. Meyer, C. B. and Stensaker, I. G. (2007), note that there is a potential danger to be too focused on routines because “different change goals and content sometimes require different approaches with other routines”. Also within the same type of change there must be a certain flexibility to adjust to different cultures and entities within the same organization.

4. Selectively including people

The fourth technique concerns protecting employees from the pressure that extensive involvement in multiple change may give. Therefore it is necessary to be selective when choosing who should be involved in the process. Meyer, C. B. and Stensaker, I. G. (2007), recommend the managers to “distinguish more clearly between different purposes for involvement, thinking carefully about when organizational members should be involved, and considering how organizational members could be involved most effectively”.

They mention that there are at least two different reasons for involving managers and employees in a change process:
- Individuals are involved to provide input to the change process.
- Individuals are involved to create ownership, motivation and an understanding for the change content and process.

Meyer, C. B. and Stensaker, I. G. (2007) question whether necessary input and views require extensive involvement, because some managers claim that good communication may replace involvement. This is because employees have become more experienced with change processes, and know the process routines and are therefore more willing to accept a lower degree of participation. In organizations that are used to pursue multiple changes, employees seldom question why changes are made. They understand the need for change. Thus, they argue that the second reason for involvement mentioned above is not that essential.

The key is to not involve more people than absolutely necessary without slowing down the change implementation and carefully planning what comes when and how much actions of the change project is needed to avoid adverse effects on daily operations.

5. Alternating temporary and permanent human resources

The fifth technique describes that there is a difference between organizations that have little and much experience with change or multiple changes. Those who have little experience hire external change consultants and those who are used to multiple changes primarily rely on internal resources. They use temporary employees differently than the organizations that hire external change experts. They use them for supporting the daily operations. Meyer, C. B. and Stensaker, I. G. (2007) emphasize the benefits by hiring temporary employees for supporting the daily operations and support the permanent employees to adapt to the new practices and reducing the time span of the change project. Further there is a risk of weakening the change process when hiring external change consultants. Those who plan and manage the change project need to know the business to maintain the link between change activities and daily activities and if they are affected by the result of the changes they will more likely ensure a fairer process.
APPENDIX 5 Learning and knowledge tools (Number of pages 4)

Strategy development

This competency relates to how an organization might start to look at its knowledge and learning in a strategic manner. The tools presented provide different frameworks which can be used to plan, monitor and evaluate knowledge and learning initiatives.

1. The Five Competencies Framework

The first tool in this guide explains how to apply the Five Competencies approach, and therefore serves as a starting point for readers, to help establish clear rationale and entry points for using this toolkit.

2. Knowledge Audit

Knowledge Audit provides a structure for gathering data, synthesizing findings and making recommendations about the best way forward for knowledge and learning initiatives against a background of the broader structural, operational and policy factors affecting an organization.

3. Social Network Analysis

Social Network Analysis has been called the most systematic way of analyzing relationships and knowledge flows between individuals and groups. Properly undertaken, SNA can yield invaluable data about how to tailor and focus knowledge and learning activities to organizational needs.

4. Most Significant Change

Most Significant Change is a narrative-based mechanism for planning programs of change. As so much of knowledge and learning is about change, and this change takes place in a variety of different domains, the MSC tool could prove invaluable.

5. Outcome Mapping

Outcome Mapping is a participatory planning, monitoring and evaluation methodology which focuses on the contribution of a program to changes in the actions and behaviors of the ‘boundary partners’. Applied to knowledge and learning strategies, OM has a number of potential benefits.

6. Scenario Testing and Visioning

Both of these tools focus on the future of an organization, and enable imaginative and creative ideas to play a central role in developing and rolling out knowledge strategies.

Management techniques

If leadership is the process of working out the right things to do, then management is the process of doing things right. Here are a range of simple approaches, from assessing managerial responses to mistakes, to assessing the forces for and against stated organizational changes, which might prove useful to managers working towards the learning organization.

7. The SECI Approach

This approach, made popular by Japanese management specialists Nonaka and Takeuchi, is based on systematically managing the conversion of tacit to explicit knowledge, through four easy-to apply processes based on simple principles of group dynamics.
8. Blame vs. Gain Behaviors

Managing a learning organization requires a managerial approach to mistakes which is healthy and balanced, and which encourages staff to take certain risks and to be honest about the consequences of their actions. This simple process enables groups to reflect on their own approach to mistakes and errors, and how they might go about addressing these, through use of a series of generic ‘Blame’ or ‘Gain’ behaviors.

9. Force Field Analysis

Force Field Analysis enables teams to work out what their goals are, and systematically to identify the forces for and against achieving them. This is the classic change management tool developed by Kurt Lewin, pioneer of action research, and can be an empowering and energizing tool for teams.

10. Activity-based Knowledge Mapping

All activities require different inputs and generate outputs; increasingly, these inputs and outputs are information based. This tool, which has been drawn from the field of ‘business process re-engineering’, enables the mapping of inputs and outputs for key activities, with a view to improving their efficiency.

This provides managers with an in-depth understanding of the different processes they are overseeing.

11. Structured Innovation

This tool works by listing the characteristics of a specific problem, and brainstorming the possible variations. Done correctly, this tool enables groups systematically to generate new ideas and assess their potential. This is useful for managers who feel the need for more creativity.

12. Reframing Matrix

Everyone sees problems in different ways, and one of the key problems with knowledge strategies is that knowledge is in the eye of the beholder. This tool enables different perspectives to be generated, and used in management planning processes.

Collaboration mechanisms

When working together with others, the whole of our efforts often proves to be less than the sum of the parts. Why? Frequently, there is not enough attention paid to facilitating effective collaborative practices. The tools in this section can be applied to reflect on the workings of teams, and to help strengthen relationships and develop shared thinking.

13. Teams: Virtual and Face-to-Face

This tool enables teams to work through five stages towards a ‘shared responsibility’. Either face to face or virtually, teams can cross the five stages assessing where they lie in terms of different areas, including atmosphere and relations; goal acceptance; information sharing; decision making; reaction to leadership; and attention to the way the group is working.

14. Communities of Practice

Communities of Practice enable similarly minded interacting people to work towards generating and collaborating on knowledge and learning initiatives in a variety of ways, through a number of overlapping functions.

15. Action Learning Sets

Action Learning Sets are a structured method enabling small groups to address complicated issues by meeting regularly and working collectively. This tool is geared especially learning and personal development at professional and managerial levels.
16. Six Thinking Hats

This tool offers a way out of the habitual thinking style by enabling participants to use different approaches and perspectives to analyzing decision making. This is particularly useful in that it allows a broad and objective view of decisions, and one which covers more options and possibilities.

17. Mind Maps

Mind Maps are a graphic technique to enable participants to implement clearer thinking in their approach to many different tasks. It is useful both for individuals and for groups, and provides as nonlinear method of organizing information.

18. Social Technologies

Social Technologies cover a broad range of tools, all using technology to build collaboration and sharing of tacit knowledge. There are many different forums for this, chiefly internet-based tools but also including telecommunications, radio and face-to-face socializing.

Knowledge sharing and learning

So much of effective knowledge and learning is about two-way communication which takes place in a simple and effective manner, and applying simple techniques to try and build on past experiences to improve activities in the future. These essential tools are covered in this section.

19. Stories

Storytelling is an approach which can both allow for expression of tacit knowledge and increase potential for meaningful knowledge sharing, particularly by permitting learning to take place through the presence of a narrative structure.

20. Peer Assists

This tool encourages participatory learning, by asking those with experience in certain activities to assist those wishing to benefit from their knowledge, through a systematic process, towards strengthened mutual learning.

21. Challenge Sessions

Challenge Sessions are a structure framework geared towards solving problems by allowing participants to supplement their habitual thinking with new methods, centered around working towards dealing with problems that are made up of conflicting requirements or challenges.

22. After Action Reviews and Retrospect

The After Action Review facilitates continuous assessment of organizational performance, looking at successes and failures, ensuring that learning take place to support continuous improvement in organizational learning and change.

23. Intranet Strategies

Intranets can have a great impact on knowledge management, particularly in the fields of information collection, collaboration and communication, and task completion. Following the necessary approach, this tool can substantially increase the likelihood of an effective, useful system within an organization.

24. Email Guidelines

Email is one of the most commonly used communication tools in the modern business environment; there is an increased need nowadays to manage this tool to reduce the risk of overload. This tool helps to control this tool and therefore increase its effectiveness as a communication tool.
Knowledge capture and storage

Knowledge and information can leak in all sorts of ways and at all sorts of times. To make sure that essential knowledge is retained by an organization requires, a range of techniques can be applied, from traditional information management tools such as shared drives, as well as more modern techniques such as blogs and knowledge based exit interviews.

25. Taxonomies for Documents and Folders

This tool has been in existence for many decades in the form of classification schemes and indexing systems, and still can have a great deal to offer in terms of structuring information for easier management and retrieval.

26. Exit Interviews

Exit Interviews represent a specific learning process, not just a way to leave a company, and one which highlights the importance of capturing and storing know-how. This can minimize the loss of useful knowledge through staff turnover and ease the learning curve of new staff, benefiting both the organization and the leaving staff.

27. How To Guides

This tool enables the capture, documentation and dissemination of know-how of staff within an organization, to help them make better and wider use of existing knowledge. The ultimate goal is to capture an effective sequence or process with enough accuracy so that it can be repeated with the same good results.

28. Staff Profile Pages

Using this tool, an electronic directory storing information about staff in a given organization, can facilitate connections among people through systematizing organizational knowledge and learning initiatives.

29. Blogs

A Weblog in its various forms enable groups of people to discuss electronically areas of interest in different ways, and to review different opinions and information surrounding such subjects.

30. Shared Network Drives

Shared Network Drives work in most organizations to store and categorize information. If used correctly, and under systematized good practices, they can enable better retrieval of knowledge and improved information sharing across an organization.

(Ramalingam and the Research and Policy in Development (RAPID) 2007)
APPENDIX 6 Freudian-, Social-, Behavioral-, Cognitive psychology of environmental problems (Number of pages 2)

Interesting aspects drawn from Freudian-, Social-, Behavioral-, Cognitive psychology, related to environmental issues, provides insight about changing individual behavior, thoughts, feelings, physiological reactions or beliefs is presented in Appendix 6.

“Freud said that we defend ourselves from anxiety by “splitting” our awareness. We seek comfortable housing, delicious food, stimulating entertainment, personal mobility and successful careers. Each of these desires lead us to behaviors that we know contribute to a pending ecological collapse, an event so dire and overwhelming that we cannot fully fathom its consequences. An ingenious solution is by splitting our awareness we can both maintain our behavior and still retain our knowledge of reality. It is this state that most of us live in, we continue with our destructive behavior while paying some, although not full, heed to the mounting threats to our ecosystem. Defense mechanisms are rationalization, intellectualization, displacementation, suppression, repression, denial and sublimation.” (Winter and Koger 2004)

“From a Freudian point of view, we must gradually confront our defenses, loosening them slowly so that we may go beyond them without being overwhelmed by the anxiety they help manage. To do this, we must be willing to experience gradually increasing states of discomfort. For example, we cannot begin the difficult problem of environmental clean-up until we allow ourselves to feel anger, disgust or guilt that confronting our waste sites might impose. We must be willing to acknowledge dismay, sadness and fear about our environmental predicament in order to free up the psychic energy now used by the defenses to be used in more creative problem solving.” (Winter and Koger 2004)

“From a Freudian perspective, you can begin to create a sustainable world in the following ways:

1. Being willing to experience your own despair, anxiety, sadness or anger over a faltering physical world and the enormity of the global dimensions that drive its environmental crisis; expressing those feelings fully in a safe place so that energy ordinarily used by your defenses can be freed up and redirected to creative solutions.

2. Recognizing your own defenses and work gently with them; seeking out troubling information and notice how uncomfortable it makes you; notice your reactions that help you avoid discomfort and gently choosing alternative behaviors.

3. Recognizing your own unconscious needs to express personal identity through material consumption; finding alternative ways to direct your energy and your needs for self-fulfillment.

4. Choosing a specific project for helping create a sustainable world and allowing yourself the latitude to be inconsistent ambivalent anxious or inefficient as you complete it.” (Winter and Koger 2004)

“The message from social psychology is that changes are easier to make and keep if we put ourselves in social situations that support them. Our immediate reference group of friends, relatives and colleagues are enormously powerful social influence agents. When group values stay unchanged the individual will resist changes. Social psychology is limited, since not all of our behavior is a product of group influence. Resisting the group, experiencing conflict with its norms and acting on the basis of more deeply seated personal norms also occur in our daily experience.

Although we are materially better off than ever before, research shows that we are not happier. Overconsumption, facilitated by a form of applied social psychology known as advertising, is depleting the planet’s resources as well as our own psyches.” (Winter and Koger 2004)

“Behavioral psychology explains that the environmental problems stems from that we have considered ourselves separate from or even above our natural environment. This thought suggests us to see our unity with the environment, not to see ourselves as victims but as agents, consumers, restorers, reactors and designers.” (Winter and Koger 2004)

“Cognitive psychology suggests the following steps to become better environmental citizens:
1. **Getting better information and acting on it.** For example, asking difficult questions about environmental issues, pursuing answers, even when they are not forthcoming, and learning more about environmental consequences of our actions, especially our consumer choices and expressing our preferences to store managers and legislators.

2. **Notice and correcting our reasoning errors.** Specifically, forcing ourselves to make a counterargument in order to appreciate other sides of complex issues, being willing to admit that our information and/or reasoning is flawed and being open to learning more about our limitations.

3. **Taking personal responsibility,** by being confident enough about our intelligence to learn more about complicated issues and refusing to leave environmental solution efforts entirely to experts who may have different priorities.” (Winter and Koger 2004)
Sustainable Sites
Choosing a building's site and managing that site during construction are important considerations for a project’s sustainability. The Sustainable Sites category discourages development on previously undeveloped land; minimizes a building's impact on ecosystems and waterways; encourages regionally appropriate landscaping; rewards smart transportation choices; controls storm water runoff; and reduces erosion, light pollution, heat island effect and construction-related pollution.

Water Efficiency
Buildings are major users of our potable water supply. The goal of the Water Efficiency credit category is to encourage smarter use of water, inside and out. Water reduction is typically achieved through more efficient appliances, fixtures and fittings inside and water-wise landscaping outside.

Energy & Atmosphere
According to the U.S. Department of Energy, buildings use 39% of the energy and 74% of the electricity produced each year in the United States. The Energy & Atmosphere category encourages a wide variety of energy strategies: commissioning; energy use monitoring; efficient design and construction; efficient appliances, systems and lighting; the use of renewable and clean sources of energy, generated on-site or off-site; and other innovative strategies.

Materials & Resources
During both the construction and operations phases, buildings generate a lot of waste and use a lot of materials and resources. This credit category encourages the selection of sustainably grown, harvested, produced and transported products and materials. It promotes the reduction of waste as well as reuse and recycling, and it takes into account the reduction of waste at a product’s source.

Indoor Environmental Quality
The U.S. Environmental Protection Agency estimates that Americans spend about 90% of their day indoors, where the air quality can be significantly worse than outside. The Indoor Environmental Quality credit category promotes strategies that can improve indoor air as well as providing access to natural daylight and views and improving acoustics.

Locations & Linkages
The LEED for Homes rating system recognizes that much of a home's impact on the environment comes from where it is located and how it fits into its community. The Locations & Linkages credits encourage homes being built away from environmentally sensitive places and instead being built in infill, previously developed and other preferable sites. It rewards homes that are built near already-existing infrastructure, community resources and transit, and it encourages access to open space for walking, physical activity and time spent outdoors.

Awareness & Education
The LEED for Homes rating system acknowledges that a green home is only truly green if the people who live in it use the green features to maximum effect. The Awareness & Education credits encourage home builders and real estate professionals to provide homeowners, tenants and building managers with the education and tools they need to understand what makes their home green and how to make the most of those features.
Innovation in Design
The Innovation in Design credit category provides bonus points for projects that use new and innovative technologies and strategies to improve a building’s performance well beyond what is required by other LEED credits or in green building considerations that are not specifically addressed elsewhere in LEED. This credit category also rewards projects for including a LEED Accredited Professional on the team to ensure a holistic, integrated approach to the design and construction phase.

Regional Priority
USGBC’s regional councils, chapters and affiliates have identified the environmental concerns that are locally most important for every region of the country, and six LEED credits that address those local priorities were selected for each region. A project that earns a regional priority credit will earn one bonus point in addition to any points awarded for that credit. Up to four extra points can be earned in this way

(U.S. Green Building Council (USGBC), www.usbgc.org)
A practical definition of specific performance aspects relevant to GB and SB

- Fuel consumption of non-renewable fuels
- Water consumption
- Land consumption
- Materials consumption
- Greenhouse gas emissions
- Other atmospheric emissions
- Impacts on site ecology
- Solid waste / liquid effluents
- Indoor air quality, lighting, acoustics
- Longevity, adaptability, flexibility
- Operations and maintenance
- Social and economic considerations
- Urban / planning issues

The areas that are covered:

(A) Site Selection, Project Planning and Development
  A1 Site Selection
  A2 Project Planning
  A3 Urban Design and Site Development

(B) Energy and Resource Consumption
  B1 Total Life Cycle Non-Renewable Energy
  B2 Electrical peak demand for facility operations
  B3 Renewable Energy
  B4 Materials
  B5 Potable Water

(C) Environmental Loadings
  C1 Greenhouse Gas Emissions
  C2 Other Atmospheric Emissions
  C3 Solid Wastes
  C4 Rainwater, Stormwater and Wastewater
  C5 Impacts on Site
  C6 Other Local and Regional Impacts

(D) Indoor Environmental Quality
  D1 Indoor Air Quality
  D2 Ventilation
  D3 Air Temperature and Relative Humidity
  D4 Daylighting and Illumination
  D5 Noise and Acoustics

E Service Quality
  E1 Safety and Security During Operations
  E2 Functionality and efficiency
  E3 Controllability
  E4 Flexibility and Adaptability
  E5 Commissioning of facility systems
  E6 Maintenance of Operating Performance

F Social and Economic aspects
  F1 Social Aspects
  F2 Cost and Economics

G Cultural and Perceptual Aspects
  G1 Culture & Heritage
  G2 Perceptual

APPENDIX 9 Økoprofil (Number of pages 1)

Environmental aspects of buildings:

- YTRE MILJØ
  - Utsipp til luft
  - Utsipp til grunn
  - Utsipp til vann
  - Avfallshåndtering, helse-og miljøfarlige stoffer
  - Utearealer
  - Transport

- RESSURSER
  - Energi
  - Vann
  - Materialer
  - Land

- INNEKLIMA
  - Termisk klima
  - Atmosfærisk klima
  - Akustisk klima
  - Aktinisk klima
  - Mekanisk klima
  - Tverrgående faktorer

(Byggemiljø, www.byggemiljo.no)