A Nordic Innovation manual

Results from the “Adaptable house” project group
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And thank you also to the team in Herning

- Eli Sahlholdt
- Svend Post
- Morten Post
- Lars Jespersen
- Charlotte Hedegaard Johannesen
- Betina Engholm
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And all the dozens of people working hard to make villAlive come through

And thank you Tanja Wetterstein for proofing reading the text and layout

Title: Create Valuable Buildings – A Nordic Innovation Manual		
Nordic Innovation Centre (NICe) project number: 05079		
Author(s): Ivar Moltke		
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Abstract: This report is in two sections: 1. A manual for creation of valuable buildings (text) 2. Experiences from building a valuable building: villAlive (photos + text) After centuries of cost cutting efforts in the construction sector Nordic Innovation funded this project to investigate the other part of the cost/benefit equation: Benefit. We focused on new technology and business models increasing the value for the users, and enhancing their quality of life: 1. An adaptable house is home - a state of mind 2. Suitable to different environments and designed to improve the environment 3. Lifecycle quality and affordable individuality 4. Innovations, taking into account different stages and sectors of life 5. Better every morning 6. Synergy and symbiosis with house – you shape your house and it shapes you 7. Continually fulfilling user needs and desires – learning 8. Built in value and integrity making it worth adapting 9. Learning from tradition, practice and local values 10. Upgradeability, should maintain superiority, and be reusable or recyclable		
Topic/NICe Focus Area: Innovative Buildings, - room for humans		
ISSN:	**Language:** English	**Pages:** 80
Key words: Value, User centred, New technology, New business models, Innovation, Energy, Quality of life		
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Executive summary

In the contract the objectives were defined:

"Concepts for components, buildings and business models creating more value for customers and producers"

The ambition is to provide the Nordic building component industry a competitive advantage through invention of free market, life cycle adaptable industrialized building technology. These new products should be so functionally and emotionally attractive that consumers will prefer them for other reasons than construction cost and yet minimize life cycle cost. The goal is reached through mass customization and user centered innovation utilize knowledge among consumers and lead users in search of the innovative kind of thing's "You didn't think about but can't live without".

The ambition is to:

- Create a premium brand identity of industrialized buildings
- Use mass customization to provide more choices and identity than ordinary buildings
- Use automated tools and rapid prototyping to provide components in artistic shapes
- Use high tech to provide high performance components
- Introduce the "Dell of housing", the missing link between consumers and component industry

The project will use the computer age technology to produce better houses with enhanced user centered performance and low life cycle cost, rather than compete on discount price.

This study has achieved these goals by:

- Surveying global cutting edge knowledge
- Focusing on value for the users from day one and on benefit in the cost/benefit equation
- Making the experimental house the key attraction of the building exhibition BYG 07
- Showing an architecturally attractive curved "box" as alternative to containers in systems like BoKlok
- Creating enthusiasm among a growing number of industries

Method

The 25 person work group below has met in 3 workshops about

- Vision & value
- Business model
- Technology

Plus 4 public workshops in the Nordic countries with a total of 100+ participants.

Main results

- The exhibition house villAlive
- The findings of this report
- Initiation of an ERABUILD Plug&Play R&D project continuing the work on component level

Recommendations for continued studies

- Building a demonstration house
- Development of robot 3D printer technology
- Software tools for imagination

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IMAGINE BUILDINGS:

- That really make a difference to the user
- Supporting your optimal performance
- Buildings you can influence, shape, develop
- That learn from your life
- That make you feel better every morning you wake up
- Cure winter depression with plenty of daylight
- With perfect indoor climate, no noise, fresh air
- Cleaning automatically
- Perceived from the interior rather than the exterior

Designed with

- Sensual shapes and amazing daylight
- With a continuous rather than discontinuous shape without troublesome junctions
- A theatre like large empty volume divided and screened by removable walls and filled with artefacts
- A small area but a large volume you can fill with decks and extend with additions
- The old alcove concept (recess in a room, screened off by pillars, balustrade or drapery) creates a “pull down menu” functionality when needed
- A room which is beautiful when empty as well as when gradually divided by partitions
- Multimedia art expressing what home is all about
- Composed from a variety of facade components and systems like balconies, terraces, sunshades, solar heating, photovoltaic, bay windows, windows, walls etc.
- Reflective surfaces that can mirror clouds, sky, sunsets and surroundings
- A fruitful garden-like interior, with fountains and flowers
- Encouraging us to break out of the box and achieve greatness
- Supporting, encouraging and developing diversity

Designed in dialog with the users, with:

- A kind of “20 questions to the professor game” sampling good architecture in a dialog with expert systems and experts
- An ICT expert system preventing solutions that do not fulfil building regulations and functional demands
- The holistic concept where a building is “sliced” in transportable modules combined with a milling robot that can produce with great accuracy without limitations to design
- The scanning technology will have a large potential in reconstructions and retrofits

Financed

- With a pay back time based on realistic evaluation of life time of the particular building encouraging more durable, healthy and sustainable buildings
- Using leased transportable modules
- Based on a self assembly montage system as simple as the self assembly IKEA furniture

Sustainable

- Absorbing CO_2 through green plants
- Producing more energy than consumed
- Collecting rainwater and use it to substitute drinking water
- With super insulating transparent materials and components that filter excessive sunlight and convert it to electrical energy
- Dynamic heat supply exactly where it is required right next to your body instead of general space heating
- Automation based on self organising biological thinking, and genetic evolutionary algorithms
- With materials that change shape and properties creating new opportunities for filter/interfaces with nature and the eco-system
- With new energy converters like fuel cells making the buildings autonomous, producing both heat and electricity in symbiosis with solar heating and photovoltaic
- A system of reusable recyclable modular plug & play components dramatically increasing the components' life span and reducing the embodied energy and waste from building materials
- A building structure that is so general it can be used by different users, for different purposes, at different times

Living for ever because it is

- An attractive house
- Adaptable to new functionality and new users
- Easy and inexpensive to repair and maintain
- 0-energy

With a new kind of rooms

- A (refrigerated) E-business locker accessible by the delivery man
- A theatre room utilising the height of the room to store furniture and artifacts not in use – much like IKEA's 3D thinking
- Theatre like flexibility
- Large doors connecting indoor with outdoor
- Feng Shui, meditation like rooms for brain still, silence
- A bounty land tropical beach paradise bathroom, wellness room
- Multipurpose Swiss army knife like room and furniture
- Pervasive computer and media presence
- Co creation slow food BBQ like kitchen merging cooking and eating to make the entire process social

Improving the environment

- Make low-value sites and buildings attractive
- A hierarchy of domains to create social interaction and social life
- Public areas like streets and squares, preferably covered and protected in severe weather conditions and open when the weather permits it
- Semi private areas between the public and the private area.
- In the office buildings, the meeting room, canteen and auditorium could be such semi private areas.
- In a home it could be the porch, terrace, balcony facing the street as well as a welcoming entrance hall. Places to stop and talk when you have met someone
- Private areas in the office, home and garden where people can sit with their back protected, raised a little above the pavement in order to have eye contact with passers by

- Places with experiences that attract people. Cafés, chairs, merchandise etc. causes people to sit and interact
- Reintegration of work and residential areas taking advantage of the workplace facilities like conference room (for parties and cinema), cantina (for restaurants) and visa versa. It also saves a lot of parking places and ad activity and life to the streets
- Space for sport and play
- Workplaces in an suburban area where people want to live like in Silicon valley
- Removing commuting barriers by increasing speed, regularity and frequency of public transportation in order to reduce car traffic
- And/or to substitute commuting some days with ICT
- With manmade landscapes, parks, lakes, beaches instead of an asphalt jungle
- Planned for more house with a view

Built by an industry offering

- Value as perceived by users
- Adaptability
- Out of the box architecture
- Mass customisation
- 20 year service agreement and warranty like Toyotas factory made houses in Japan
- Open Plug&Play system for architectural design
- Adapting to any European building code
- E business and one stop shopping
- Design, co-design and dialog with customers
- User community
- Facility management taking care of the house, keeping it safe and sound
- Updates to software in home automation
- Hotline support for “do it yourself” maintenance and updates
- Financial partners’ interest in a positive development of property value

Using one or more of these innovative integrated design and production tools

- Keeping the entire model in-house like NCC Komplett
- An open source model adding modular components ordered from the internet, adding up to a complete house
- A kind a docking-station concept where you add entire prefab rooms, even stacked on shelves (like Open house)
- A kind of New York loft model where you build a void space, a store room, and fill it with highly adaptable modular self assembly Plug&Play furniture like partition elements, bathroom units
- A holistic approach where you design whatever shapes you want and slice the design in units transportable within the 40 feet container volume
- On site production with robots

Produced with

- More industrial robots in production
- The present human process of building could be mimicked by humanoid robots only without mistakes and errors.
- Plug&Play components
- Alliances with subcontractors
- Test, quality, extended warranty, service contract

- A life cycle perspective: 0-energy, renewable materials & energy, sustainable architecture
- Universal Adaptable Standardised Interface between components
- All HVAC installations, bathroom, kitchen etc. in one 40´ container unit to be sold worldwide
- ICT making the house and home understand you

Including new technologies like:

- (Self-) cleaning and repairing nano surfaces
- Pervasive and augmented
- Fulfilling your every need without in any way being visible or noticeable
- Fuel cells and photovoltaic

BENEFIT

After decenniums of cost cutting efforts in the construction sector, Nordic Innovation funded this project to investigate the other part of the cost/benefit equation: Benefit.

Benefit is both about:

- Quality of life benefit, that is, what the buildings do to enhance your quality of life
- Financial benefit, that is, what it does to enhance your financial situation
- Sustainability benefit: more efficient use of energy, environment & resources

Darwinism is about survival of the fittest most adaptable species and the most attractive for reproduction. “Long lasting architecture is about survival of the fittest most adaptable buildings and the ones most attractive to the users. As long as you love your house more than you hate it, it survives.”

The valuable old buildings -“vernacular architecture”- are a source of inspiration because they actually survived. They were fit for and adaptable to the past changes and they are still attractive. How can this knowledge be extracted? And how can we translate, project, transform the success in the past lifestyle with success in future lifestyle?

Look at the in every meanings most valuable old buildings and compare their market value with their initial construction cost. And do the same for the least valuable buildings. The ration between benefit and cost is most likely 10 times better for the good buildings, “particularly if they are in a good neighbourhood”. The point is however not that “old” is better than “new”. The point is that valuable is better than discount.

Most construction companies build very conservative “business as usual” assuming that the second hand market shows what people really want. But how can people choose something not available? How will we ever get improvement if the new buildings are determined by the average second hand market?

Most constructors, developers, real estate agents, focus on the financial gains that can be made during the construction process. From a sustainability / life cycle point of view, the real benefit is within the next 100 years. And the real cost is also within the next 100 years if the building consumes energy, is expensive to repair and maintain. That is if the building survives that long. A lige cycle expensive building will probably be torn down and demolished before.

The owners of the good buildings care for them and make them better. We want to live in a neighbourhood where people care for their environment and care for each other. That is the feed back process.

A successful office building is catalysing economical and personal growth. The turnover on salaries is maybe ten to twenty times the annual operation cost of the building. Not only facility management, but also human resources should be included in the cost/benefit equation.

Every single thing you can do to make it easier to love and to avoid that you hate your house will save resources, embodied energy and waste, providing you use sustainable products. And that will increase BENEFIT in every possible way.

QUALITY OF LIFE BENEFIT

The challenge is to design houses

- ***To become homes***
- ***Providing a stimulating environment***
- ***You can influence, shape and develop***
- ***Learning from your life***
- ***Providing shelter and privacy***
- ***Making you feel better every morning you wake up***
- ***Adapting to, and improve their environment***

Increasing returns

Feed back processes are fundamentally different from linear processes. They can grow exponential 2-4-8-16-32-64-128-256. Feed back processes are usually based on intangible issues like:

- Confidence
- Trust
- Friendship
- Love
- Knowledge
- Empathy
- Success
- Sympathy
- Care

All these things grow when they are shared. If you can create an environment based on these factors you can start a good circle of increasing benefit.

Buildings are not static. They interact with the users. Users living in a good environment are more healthy and productive than those living in a bad environment. How do you create a good environment that supports you?

How can you design buildings to create a supportive environment, and harvest the benefits?

ADAPTABLE

User centred

The aim of architecture is for man to prosper, develop and be productive. The real benefit is neither found in the building alone, nor in the user by himself, but the relation between excellent building and the empowered user. Real benefit is found in what difference the house makes to your life!

A home is different from a house. The home tells the history of your life trough a lot of artefacts from you family, from your journeys, the gifts you have received and the things you have chosen. A home manifests the love, friendship and collaboration between the people that inhabit it. A home is uniquely you.

Quality of life is experienced with all of our senses. Sight, sound, smell, touch and taste because it is a difference that makes a difference in your brain that counts. A candlelight dinner is an example of a situation where all of the senses are stimulated.

We people are all very different. That is not a problem. It is a resource. Diversity combined with natural selection is the formula for both genetic development of species and development of new ideas.

Such stimuli are not confined to our home. The city is an example of a situation where we choose where to go for stimulation. To stimulate the sight and sound we go to a cinema. To stimulate human contact we go to a café. To stimulate our taste we go to a restaurant. To stimulate our body we go dancing.

Change comes when the audience becomes the actors. When you yourself decide what you want to do, how it should be done and what kind of space and interface is necessary to set the scene.

User co-creating architecture is a way of telling others about who you are, what you do. It could also be a real inspiration for creating new relationships and lead to a dynamic exchange of ideas and methods.

User centred design has a specific challenge when it comes to buildings: Time. A building lasts for 100+ years and it is not sufficient that the first user can customise the building. The usual consequence is that user centred design of buildings are abandoned: “Why should the first user destroy it for the following?” But that is based on the false assumption that buildings are fixed. Why not make the building adaptable?

A building should support the user’s development. The building should be able to adapt to the users, their changing life, and the next users moving in when the first are gone.

This means that the building should be adaptable, either because it is made of materials like wood and bricks that are easily changed or by, modular, Plug&Play components

The relevant user centred design is a kind of dynamic user co-design where each home is a prototype developed within a modular framework where some choices can be made over again.

User co-design could even be real time. Imagine an office where you choose where to sit, based on who you collaborate with today, how you like the daylight and where the nice temperature is. This collides of course with the concept of “home” in your office unless your “home place” is mobile or even virtual regenerated the moment you sit down.

Functional and efficient

Buildings are also a tool in our life.

- A kitchen is a tool for cooking
- A bathroom is a tool for hygiene
- A bedroom is a tool for healthy sleep

- A living room is a tool for social life

Ergonomic studies, Feng Shui and anthropology can help us make these tools better.

Efficiency is also a question of space utilisation. Any kind of Swiss army knife multi functionality saves space. The traditional Japanese room can be used for any purpose.

Multi purpose Swiss army knife functionality is a great challenge for architecture.

SHELTERING

Shelter

Particularly in the Nordic winter climate houses are a matter of life or death. Actually most people in the Nordic countries live more than 90% of their life indoors. This is another reason why we in the Nordic countries are particularly concerned about building interiors.

In the Nordic countries houses are perceived from the interior rather than the exterior.

Safe and secure

In the Nordic countries, the building code protects the safety of the occupants and the police protect the security. Security can however be increased with:

- A safer neighbourhood where you can watch the sidewalks and know your neighbours
- ICT surveillance systems in the house

Security is essential, yet difficult to translate into economics. To get an impression, you can look at your spending for insurance. Insurance companies bill different in different neighbourhoods and depending on security surveillance systems.

Could the house factory support house security with a discount insurance to capitalise this benefit?

STIMULATING

Healthy

Winter depression, Seasonal Affective Disorder, is a result of the dark Nordic winters and the indoor life in buildings without sufficient daylight. If you are at work 5 days a week, daylight in offices is particularly important. You can calculate the cost of skylights, windows and heating but what is the cost of winter depression? Well, you can calculate part of that cost. One day out of work costs the office 0.5% of your yearly turnover. If your turnover at work is 100.000 € a year, it costs 500 € to be ill one day a year and that could justify an investment of 5000 € per employee. How expensive is the skylight?

Same argument goes for

- Unhealthy air-conditioning spreading diseases

- Unhealthy furniture leading to back and neck pain
- Poor acoustics disturbing flow at work
- Unfit indoor temperatures making people loose concentration

Unhealthy buildings are NEVER economically attractive if you consider productivity and days of illness. Whereas healthy buildings enhance the users' quality of life, improve their well-being and may even boost their productivity.

Many people use an hour a day in average on cleaning the house. At offices, cleaning is also a substantial bill. If you can save one hour a day, a self cleaning house is worth a 100.000 € investment.

Buildings should

- ***Cure winter depression***
- ***Support your optimal performance***
- ***Prevent spread of diseases***

Any inventions cleaning the house automatically would add to both health and quality of life.

Friendly

How can we make houses an arena for social interaction?

People in the Nordic countries are living 90% of their life indoor due to the cold and humid climate. Inside the house, the living and dining room are the rooms for friends. Some even have guest rooms.

Spontaneous social life is rather limited in the Nordic countries. We are together with family and close friends. Spontaneous social life is much easier in public areas like squares, streets, cafes. Just look at countries with warmer and more sunny climate. Why not build houses that break through the weather barrier and connect to public areas covered and enclosed to be attractive all year in the Nordic countries.

We need a hierarchy of domains to create social interaction and social life ranging through.

Public areas like streets and squares, preferably covered and protected in severe weather conditions and open when the weather permits it.

- ***Semi private areas between the public and the private area. In the office buildings, the meeting room, canteen and auditorium could form such semi private areas. In a home it would be a porch, terrace or balcony facing the street, or a welcoming entrance hall.***
- ***Private areas in the office, home and garden***

Natural

Ecology is defined as the relationship between the organism and its environment. Building ecology is about our relationship with our environment and with each other. The starting point is an examination of our social and biological requirements. Only through a deep understanding of ourselves as biological animals and human beings can we understand how to live in symbiosis with our environment.

Man developed from ape to prehistoric man in approx. 10 million years. The development from prehistoric man to modern man took a mere 200,000 years. Up until 100 years ago, the majority of people lived outdoors most of the time. It is therefore biologically necessary to reproduce those natural qualities the human body was adapted to in the first place. We are not developed to sit for hours in front of a computer. We need to move, change position, talk, relax, switch off, switch on. Outdoor qualities such as daylight, birdsong, the sound of a water fountain, aroma, fresh air – as in the garden – are indispensable to human beings.

We all know that light is important in order to see, and architects, painters, photographers, theatrical directors and film crew are often aware of light as a medium of creation. Also the human biology and psyche is strongly affected by light. One of the effects is that our immune system is strengthened through the presence of an abundance of – preferably natural – light: natural light boosts our hormone production, we are less sleepy, more alive and in a good mood.

Our biological preferences are about

- ***Protection from danger within our surroundings***
- ***Flowers and fruit as a signal for food and scent***
- ***Falling water, spring water and warm water, lake, ocean***
- ***Daylight***
- ***View and sunset***
- ***Fire/heat***
- ***Birdsong***
- ***Earth, gravel, stone***
- ***Air, breeze, wind***

Including these ingredients is a powerful tool. They have been our optimal life condition throughout the last 200,000 years and they ought to be a part of our continued existence. If we can utilise this force we have the key to positive human perception. The challenge is that recreating them artificially indoors is often not as stimulating as the real thing.

Self actualization

Imagine two different ways the same person's life can develop.

- Growing up and living in a dull box shaped house in a colourless neighbourhood he gets an average life with a 9-5 job.
- Growing up in Hundertwasser's apartments in Vienna he gets a taste for and experience with the far from average and wants to achieve the extraordinary.

If buildings can change our lives that is hard to overestimate. It is priceless.

Buildings should encourage us to break out of the box and achieve greatness.

STORYTELLING

Storytelling

A home is the storybook about your life. You exhibit

- Items collected from travelling
- Gifts you have received from friends and family
- Things your family has made
- Trophy from sports victories
- Art and decorations of your choice
- Things you have inherited
- Books indicating your knowledge

A home should provide space to exhibit those items.

Buildings can be part of your history, settings for important episodes in our life or just reminders of such episodes. Such historic ties create sentimental and affection benefit.

Home

There is a profound difference between a house and a home.

Home is:

- Your base, always available
- The place where YOU decide
- The place you belong

Belonging is both

- A social relation to and recognition by neighbours and neighbourhood growing over time
- A personal history and memories related to the building and the area growing over time

A house you grew up in or built/renovated yourself is more home than one you temporarily rent.

Though we all move several times during our life, most people are closely tied to their home and neighbourhood.

Theatre

Difference making a difference is this common language for all disciplines in the knowledge society. We can communicate across disciplines and be stimulated by the potential transfer between disciplines, in the collaboration at a personal meeting as well as via the Internet. See, think, react, contact, stimulate, grow. Taste is suddenly something we can discuss when we can translate it into this common language.

We play a role and have roles. This role-playing can be changed from something that limits communication to something that improves it. Consciously changing roles to investigate complexity can increase the bandwidth.

We need an architecture inspired by the theatre, where it is easy to play different roles, make new scenes, create new performances.

We need buildings as versatile as the pull down menus of the computer.

Communication is not only for humans. You can communicate with a computer and interactive computer games. And you can communicate with and through architecture.

The famous architecture you travel to see on vacations obviously communicates to you. A test of architectural quality is that many people know about it (it made a difference). The next test is the distance - you want to travel to see it, and the next test is that the experience in real life was even better than the virtual. The ultimate test is that you talk your friends into going to experience the building.

- ***Imagine a building design that really makes a difference to the user.***
- ***The theatre is a large empty volume divided and screened by removable walls and filled with artefacts***
- ***The old alcove concept creates "pull down" functionality when needed***
- ***Imaginative sensual shapes and amazing daylight***
- ***Imagine a room which is beautiful when empty as well as when gradually divided by sliding doors and partition walls***

Multimedia art

This new communication paradigm of architecture has an effect similar to the development from an electric bulb that can be switched on and off to the full spectrum of multimedia. A media screen is a million electric bulbs that can be tuned, change colour and be combined to visualise a message.

Art is the sublime communication from one subconscious mind to another subconscious mind of a difference that makes a difference. Art integrates metaphor, symbol and language in a completely new way compared to a pure physical understanding of architecture. Art is thus a precursor of development to come. You could watch Kadinsky before the Arken museum in Ishøj was built. Why not be inspired by the movie artists of Star Wars and Lord of the Rings? The best stories are often told through the subconscious of the architect and designer relying upon a sense of the instinctive and intuitive.

Art has conquered new ground through the inclusion of electronic media as a means of expression, and architecture could be similarly dynamic. From the passive to the interactive.

Architectonic artistic quality is measured as experience through the senses. Things can be psychologically hot and cold, nice to the touch, pleasant to behold, safe and secure. The ideal is a balance between calm harmony and a kind of dynamic disharmony. Both the safe, familiar and the challenging. A 'cult' movie is more our role model than an advertisement trailer is.

Our work place is characterised by both internal and external market forces. In a knowledge society the motivation to take an active part in those market forces

becomes essential. Work is a bazaar and ought to be considered a place where you can ‘shop’ between individuals and departments/specialities. With an architecture providing a framework for pluralism, ornament and decoration, setting a stage for action and interaction.

Architectural art reinforce experience between space, material, nature, light, the city and not least the subject: Us.

A building is to be experienced again and again so the difference making a difference should be alive, developing, interactive or it will stop working. A shocking design, a fashion, a fad won’t work in something lasting a hundred years.

Architecture can be dynamic. Alive. Something that is constantly changing according to the needs of the user. Something that can open and close, change between filter and interface. The industrial age concrete elements are replaced by a flexible, adaptable consciousness born out of the information age.

The users co-design and co-construct the building over time according to purpose, and make it their own theatre for the dramas of life.

- ***When you walk down the pedestrian streets in the city centre, it is the same street next year but most likely with different shops, exhibitions and displays. The pedestrian street is multimedia, dynamic***
- ***Buildings, offices and neighbourhood could be dynamic like a town***
- ***Buildings could be multimedia art expressing what home is all about***
- ***Facades could be composed from a variety of facade components and systems like balconies, terraces, sunshades, solar heating, photovoltaic, bay windows, walls etc. preferably truly 3D***
- ***The most obvious exploration of multimedia art is artistic use of glass as a media for both daylight within the house and light art seen from outside at night***
- ***Reflective surfaces can mirror clouds, sky, sunsets and surroundings, but also create the most annoying and dangerous glare for passers-by and surrounding buildings…***

Filter/interface

You and your building are the editor of your own life.

Buildings and towns are filters/interfaces, tools for addressing, sorting, distilling and organising information. Information has input and output, resonance, frequency, strength and many other functions. It is all about selecting the information we want, enhance the part we care for and shield the part we do not care for.

We already view the world through many kinds of physical and virtual optics. Through our spoken language, our profession, our roles as parents, as colleagues, through our national culture and our sub-culture. We receive information directly through our senses, but also from TV, the Internet, books, movies and all kinds of art. They are

collectively a kind of filter/interface that reinforces certain impressions whilst repressing others.

Concentration, being undisturbed, is vital. When you think creatively the brain has to be in 'flow', a condition of synchronisation between the left and the right lobes, where both the logical left side and the associative right combine structured thinking with associative potential, resulting in a condition where creativity is nourished and thrives. It takes approx. 15 minutes for the brain to reach this level of responsiveness and just a couple of seconds to loose it. "Flow" can be experienced by both individuals and groups (synergy).

The need for the filter function grows when more information has to be processed and when you are closer together with more people; sometimes, we are indeed flooded with information.

The double function as filter and interface is repeated on many levels in accordance with the individual, family, group, institution and sub-culture.

The building as filter should uphold your preferred balance between privacy and social relations. To screen some people and information out in order to accentuate the relation with those you want to be in close interaction with. To stop one stream of information in order to concentrate upon another relation and dialog. Selection and privacy is even more essential in a society with an increasing flow of information.

The home is the place in the world where you yourself decide filtration of information. The place where you can seek isolation and retreat. Turn off the flow of information completely.

The following points are related to home, shelter and friendly:

- ***We need buildings that can provide privacy and silence. Good sound insulation, fresh air without noise through open windows, efficient acoustic absorption.***
- ***We need privacy, a good night's undisturbed sleep and the avoidance of annoyance spoiling relations to neighbours***
- ***We need facades and partition walls that can open and close, filter daylight and protect privacy.***

New rooms

New demands, changing demography, new sub-cultures, lifestyles and technology could lead to new rooms.

We need more experiments with a new kind of living in our houses and workplaces like

- ***Theatre room utilising the height of the room to store furniture and artefacts not in use***
- ***Theatre like lighting***
- ***Large garage doors connecting indoor with outdoor***
- ***Feng Shui, meditation like rooms for brain still, silence***
- ***Bounty land tropical beach paradise bathroom, wellness room***

- ***Multipurpose Swiss army knife like room and furniture***
- ***Pervasive computer and media presence***
- ***Co creation kitchen merging cooking and eating to make the entire process social***
- ***(Refrigerated) E-business locker accessible by the delivery man***

LEARNING & CARING

Parents take care of their babies and see to it that they are comfortable and safe. We do not want intelligent houses. We want caring houses. Caring for our:

- Comfort (temperature, humidity, light level, light colour, acoustics)
- Safety (fire alarm, smoke alarm, alarm if we fall or are unconscious)
- House safety (alarm for humidity within the construction)
- Functionality (alarms for break down of heating, loss of water pressure)

We even want the house to fix the problem, call for service and repair.

We want the building to understand and learn our way of living just like modern cars where the Triptronic gear box learns to shift at high revs when the driver wants sporty driving and at low revs for another driver who want economical driving. Some cars also have computers to remember how each person (each car key) wants the seat positions, rear mirror positions etc.

The first problem with intelligent house installations has so far been that they are not intelligent.

We live a complex and complicated life. When I enter my home I want the light to turn on unless there is already someone asleep in the room, or the door is open to a room where somebody is asleep. I do not want the movements of my cat to trigger the light. If I wake up in the night to go to the bathroom I do not want the light on before I have closed the door behind me, and when I return I do not want the light on in the bedroom. On the other hand, if I leave a room without closing the door behind me, I do not want the light to go off as long as I am still awake.

The second problem is that intelligent house installations don't communicate with other systems. When I leave the house and ask for "Turn of everything", the intelligent house installation turns off a lot of devices which have their own automatic controls and clocks, and they do not function when the power returns. The video, oven, boiler etc. have lost their settings, Furthermore, one system can open the windows to get rid of excessive heat while the thermostats react to the cold downdraft from the window and turn on the heat.

- ***We need an intelligent house system which is an intranet. All light, pumps, TV, oven, refrigerator, washing machine, dryer, windows, doors, radiators, ventilation and electrical devices should communicate via WLAN, Bluetooth or similar communication systems on the house intranet***
- ***Devices without their own automatics could be grid connected with a plug in device***

- ***The controlling software should have a very user friendly interface making the control of the devices easy and making it possible to be in manual control***
- ***The software should "learn" from your preferences and habits preferably in a dialog with the specific user. It should also be able to identify each user, for instance trough a unique code watch, cell phone etc.***
- ***A learning house is of course open to software and hardware upgrades and plug-in's***
- ***The house should understand and support you, but never dominate you***

Collectors' item

So far, mass market industrial construction companies have aimed at the lowest common denominator. The kind of house sold in highest numbers. New houses are built like traditional houses because there are sold more traditional houses than innovative houses. Do you realise the problem? Do not listen to this majority argument. Innovative houses are actually sold at higher square meter prices, but maybe less than 1% of the houses are innovative. If you are not convinced, open a newspaper and look at the pictures of the houses for sale. Build something really valuable and trust your intuition and analysis: It will be a hit when you sell if .....if you sell it.

Architecture can be beautiful, daring and artistic, exhibiting your style, preference and taste. The house could be tailor made to your dreams.

Diversity

Valuation differs significantly from person to person related to:

- Culture and subculture
- Education and competencies
- Age
- Sex
- Religion
- Fashion
- Lifestyle

Buildings should support, encourage and develop diversity.

BUILDING BENEFIT

There are different ways in which to look at building benefit: a short term and a long term one.

SHORT TERM: BUILD INEXPENSIVE AND SELL TO MARKET PRICE

More value is created for you if you build an inexpensive house and sell it to market price.

This is the driver behind the building of most houses. Property developers are particularly good at this process.

Look for low-value sites and buildings and make them attractive for the market.

LIFE CYCLE PERSPECTIVE: BUILD TO LAST

A house lasting 50 years and another house lasting 100 years obviously have a different value, particularly after 49 years. The problem is that this difference does not show very much because except in areas people are moving away from bacause:

- The value of the site is dominant
- 50 years in a current context is already quite long
- The (Danish) taxation is based on m2 and average price in the area while the condition of the building is not a factor
- It is difficult to tell how many years a building will last
- The depreciation is based on when the house is bought rather than on how many years it will last
- Interest rate tends to overshadow depreciation

So, how many years does a house last?

It lasts as long as you love it more than you hate it, or more precisely as long as the old house performs as good as a new one. It is torn down when:

- You can build a much nicer and more profitable house on the site due to better architecture, technology or building permission
- It is functionally obsolete and not sufficiently adaptable

The running cost of repair, maintenance and energy becomes larger than the cost of a new building. with the same qualities.

A house will live forever if:

- ***It is a very attractive house***
- ***It is adaptable to new functionality and new users***
- ***It is easy and inexpensive to repair and maintain***
- ***It is 0-energy***

Such an eternal house is obviously more valuable.

ADAPTABLE, UPGRADEABLE, RENEWABLE

We people change during our life time. We have significantly different needs and demands as babies, children, teen-agers, singles, families, senior citizens. Buildings should adapt to that, fit you in any phase of your life.

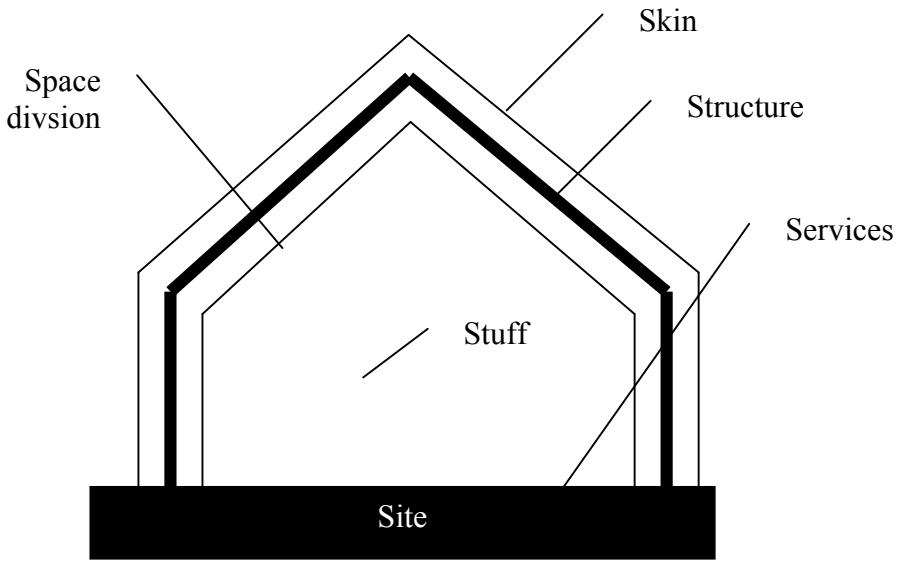
Technology and economy change during our life time. New technology is available opening up new possibilities and taking up space in our buildings. Look around you. New kitchens, ICT, new offices.

The only thing we know for sure about the future is that it will bring more changes, more challenges and new possibilities. If the building will last a hundred year you need to imagine what the situation will be in a hundred years. What has happened to the climate, to the sea level, to the energy supply, to the population.

You cannot build a house to be a hundred year ahead of time, but you can build an adaptable house that can easily adapt to all the changes.

The basic principle in the adaptable house is a hierarchy of construction spheres:

Figure from Steward Brand: ”How buildings learn”



- ***The inner spheres on this figure have a shorter life time expectancy and should be easier to move and replace***
- ***You should never integrate short life time components in long life construction spheres***

CONVERTIBLE

A convertible is a car with an openable roof top. The traditional Japanese house is a kind of convertible house. Both interior and building envelope is equipped with slide doors providing a kind of endless space.

- ***A convertible house could integrate the garden, terrace, balcony and porch in the building***

SIZE

The financial benefit of the building is traditionally tightly connected to the size, the area of the building. The benefit is however not linearly related to area. A small house sells at a higher price pr. square meter than a large one. That reflects the market mechanism rather than construction cost.

The authorities accept the size of a building based on square meters rather than volume. If you want to future proof against limitations to additions to your house, you can:

Start with a small area and double high rooms and fill in with decks.

SELF MADE

Many people are proud of the self made construction work in a house. It is a kind of manhood test to be able to build the family house. That seems particularly to be the case in Finland, but in all Nordic countries building material shops thrive.

The construction component industry already produces self assembly house kits with all the components necessary to build a house.

Transferring knowledge from the process to the product will eventually result in products that can be installed and replaced easily by anybody. When the products are sufficiently easy to install and transport, they can be delivered and installed world wide. Gradually this will shift focus from the construction process towards user co-design and global customer relation.

Eventually brands similar to IKEA, Dell, Toyota and Sony will emerge in the construction industry. In fact IKEA and Toyota are already producing houses on factories. These brands could offer building sites, financing, insurance, facility management, security, software, upgrades etc. They buy components from global players. The actual construction will still be local, but out sourced.

These brands could be the driving force in development of “Plug&Play” interfaces making the components fit together, both physically and virtually.

Will these brands be Nordic? Can we provide superior management and take this role in competition with the traditional construction industry?

The self assembly idea could be developed into a montage system as simple as the self assembly furniture from IKEA.

SUSTAINABLE

Ecology is all about the relation between a living organism and its environment.

Buildings should interface, interact and co-operate with nature without harming the environment.

Buildings should be an extra skin receiving solar energy and protecting us from the hardships of the climate; providing comfort without wasting resources.

The building is a tool rather than an object. The aim is to create a comfortable environment for human life, participation and interaction. The measuring stick is comfort and minimal environmental load rather than Celsius, Lux or square metres. Comfort depends on person, clothing and activity and is different from a specification of an indoor temperature of 22 °C.

Ecology is globally essential for the building of tomorrow. This is not just about heat loss and the effect upon the environment, but also a consideration of activity, office equipment, lighting. And all this is to be considered from a total resource perspective, even the effects of increasing production needed to afford an expensive house.

Ecology is a state of mind. A long term life cycle mindset. Every single place you can substitute and save energy consumption is worth the effort. Savings are usually less expensive in a life cycle perspective than supply. A reduction in space demand is also resource efficient.

The savings can be incremental or disruptive. Incremental if you save 10% energy and disruptive when you save the heating or cooling installation. The disruptive savings can lead to autonomy and in a world of oil-wars that means safety. If oil supplies are scarce or cut off you are still in control.
Using the car to produce electricity for the building is interesting but using the buildings photovoltaic to generate electricity for the car is a revolution.

The building could improve the environment in several ways:

- ***Absorbing CO2 through green plants***
- ***Producing more energy than consumed***
- ***Retaining rainwater and using it to substitute drinking water***
- ***New super insulating transparent materials and components filtering excessive sunlight and converting it to electrical energy***
- ***Dynamic heat supply exactly where it is required right next to your body instead of general space heating***
- ***Building automation based on self organising generic evolutionary algorithms***
- ***Materials that change shape and properties creating new opportunities for filters/interfaces between user, building and environment***
- ***New energy converters like fuel cells can make the buildings autonomous, producing both heat and electricity. They work well as back up to solar heating and photovoltaic***
- ***A system of replaceable recyclable modular Plug&Play components will dramatically increasing the components' life span and reducing the embodied energy and waste from building materials***
- ***A building structure that is so general it can basically be used by different users, for different purposes, at different times. Provided there are some modular solutions for the indoors***
- ***Recycling of materials, waste heat, etc.***

ZERO ENERGY

During the life time of a building the energy consumption is a very substantial expense. And everything points to rising energy prices. It is difficult to build a truly zero energy consuming house, but it is possible to build a house heated by the electricity used for other purposes and the heat from the occupants.

The means to achieve zero energy for heating is:

- ***300 mm insulation***
- ***No thermal bridges***
- ***Air tightness***
- ***3-4 layers of gas filled low emission windows or evacuated glazing***
- ***Ventilation with heat recovery***
- ***Photovoltaic (integrated in windows)***
- ***Solar shading***
- ***Solar hot water***
- ***Fuel cell cogeneration***

The building code is a very important driver in making houses safer better and more environmentally benign. The many different building codes, local standards and certifications are however a barrier to industrialisation.

Energy ratings of buildings in categories provide the buyers with a conscious choice concerning the long term expenses for energy. An A-rated building (low energy) will be more valuable than a C-rated. A small extra investment during construction and planning may be all it takes to get you into the better category.

It would be a great help for industrialisation if there was a EU building code with a table showing different standards for different countries. The Nordic countries could be pioneers on that.

SITE BENEFIT

We are often shy or slow in contacting unknown people. This is a barrier to potential interaction that can be broken. Architecture can be interactive functioning as an interface connecting people.

Meeting people is the beginning, but we need a variety of spaces that encourage the development of relations.

We can zoom in on the interface between people through an examination of situations where people thrive as testified to by their body language. People thrive when they:

- Look happy
- Have a body language that is as light and pliable as a soft rubber ball
- Radiate an engaged concentration
- Relax in security

Such situations can be play, sport, dance, discussions, co-operation, and flirt. It is something almost physical in its nature.

“It takes a village to rise a child” says Hillary Clinton. We need a semi private zone between our space and the public space. A space for informal meetings. An outdoor or covered space you can domesticate, A dialog space. We need the diversity of feed back from many people. Yet most people live in single family houses. We need a new architecture combining the freedom, control and ownership of single family homes with the social life of a town. Something like New urbanism, Port Grimaud (photo below)and Seaside.

Architecture should enhance the interaction between the users and between the users and the building. The one cannot exist without the other, they exist in yin and yang duality.

Your office becomes a room where the network is alive, communicates and creates new knowledge. You simply choose the filter/interface configuration that suites your particular requirements. This is not the old discussion about a cell or landscape office. This is something about the interaction of people with each other and their environment. You choose the setup you want. One of the preconditions is ICT mobility.

We need space and places

- ***To stop and talk when you have met someone***
- ***Where people can sit with their back protected, raised a little above the pavement in order to have eye contact with passers by is***
- ***With activities that attract people. Cafés, chairs, merchandise etc. causes people to sit and interact***
- ***Reintegrating work and residential areas taking advantage of the workplace facilities like conference room (for parties and cinema), cantina (for restaurants) and visa versa. It also saves a lot of parking places and ad activity and life to the streets***
- ***Space for sport and play is essential***

PROXIMITY TO ATTRACTIVE WORK PLACE

A site is valuable reverse proportional to the time and distance you commute. The cost of commuting is related to:

- Average distance to both his and hers workplace, as well as to the day care centre for the children
- Expectations of distance to future workplaces because a workplace relation lasts significantly shorter than the time you live in a house
- Disruptive cost of commuting when shifting from bicycle distance to public transportation to car
- Time factor particularly when you have to pick kids up at kindergarten.
- Cost of the hours you spend commuting. If you are paid for performance you can translate commuting hours into salary. But nonetheless you will have to spend more hours per day away from home

Commuting 1 hour every morning and evening means two hours a day. This equals for instance 60 € in salary after taxes a day, plus 100 km worth of transportation costs equalling 40 € a day, rounding up to a total of 100€ a day or 20.000 € a year. With the present interest rate of 5% over 20 years you can buy a house at an extra cost 200.000 € for one person and 400.000 € for two persons. If you can skip a car you can save another 7000 € a year and pay another 70.000 €. This is a good reason why city apartments sells at a very high price. In addition, you spend less of your life commuting and have more time to spare for other more meaning full activities.

- ***The key challenge is to create enough workplaces in suburban areas. like in Silicon valley***
- ***Or some kind of web based work without or with reduced commuting***

TRANSPORT INFRASTRUCTURE

Barriers for transportation can be removed. The Oresund Bridge has removed a barrier and immediately the property prices in Malmoe went up. If you were free to cross the bridge the prices would increase even more. Motorways have the same effect. When a motorway is opened to a peripheral district, a transport barrier is removed and people start commuting long distance to the cities. The high speed trains in Japan have removed a barrier and opened for a 300 km commuting distance (one hour). Some people even commute by plane for instance between the Nordic capitals. One hour seems to be the magic limit.

Speed is not only about the transportation time. As a commuter you have to add waiting time and delays. So frequency and regularity is just as important as the top speed.

You are prepared to commute if the cost of commuting is less than the extra salary after tax is paid. Or if your only chance of getting a job is to commute. This also means that you are prepared to accept a lower salary if you can skip both commuting and living in an expensive city area.

The challenge is

- ***To remove commuting barriers by increasing speed, regularity and frequency of public transportation***
- ***And/or to substitute commuting with ICT***
- ***To make commuting sustainable from a resource and energy point of view***

PROXIMITY TO NATURE, PARKS, LAKES, RIVERS, BEACHES

Like all other limited supply, attractive sites are expensive. They are a kind of collector's item.

- The largest effect is when there is direct access from your house to the nature.
- A sufficient effect is when attractive green areas are within 100 meters
- When you are beyond the distance of a short walk the effect is minimal

Landscape and building can be integrated when you build earth sheltered houses. Particularly Iceland and the Faeroe Islands are know for earth sheltered architecture where the building are covered with soil, stone and grass.

Attractive sites can be constructed

- ***You can create landscape, parks, lakes, beaches***
- ***And you can increase the benefit of this proximity for instance by planning for more houses with a view***

PROXIMITY TO SHOPS, SCHOOLS, LIBRARY, RESTAURANTS ETC.

The city centres can provide all kinds of services and facilities.

City functionality can be created in suburban areas:

- ***Utilising the facilities of the offices and workplaces***
- ***Integrating the school buildings in the hobby life***

- ***Using corporate canteens for restaurants***
- ***Making corporate libraries public***

ATTRACTIVE NEIGHBOURS

The attractive neighbours are where people:

- You want to be friends with live
- You want your kids to be friends with their kids live
- That accept you and want to be friends with you live

People tend to move together with their own kind of people.
Sometimes this leads to attractive neighbourhoods, sometime to ghettos

- ***How can you actively attract good neighbours to create an attractive neighbourhood***

ATTRACTIVE NEIGHBOURING BUILDINGS

The benefit of the whole neighbourhood increases when **all** buildings are:

- Nice
- Well maintained
- Have nice gardens, streets, squares etc.

Of course genuine historical buildings add an extra flavour

Neighbourhood is of paramount importance. Buildings designed to encourage a good neighbourhood are more valuable

- ***Both buildings and neighbourhood should focus on quality rather than cost***
- ***Each building should be upgradeable encouraging growing value***
- ***Each building should add to rather than subtract from the neighbours house***
- ***Each building should improve the environment***
- ***You can organise such collaborative effort to make a neighbourhood attractive***

DISTRICT HEATING

Low cost heating provided by co-generation of heat in a power station or by natural gas supply is a benefit that can be transformed into higher price of a building. This effect should however be carefully evaluated as the energy technology might change:

- 0-energy houses might make heating obsolete. This is already the case for low-energy housing in Norway. The heating demand is so low that connecting to a district heating circuit is useless. You need heating maybe in December-January-February. A small stove would suffice
- Natural gas can be used for fuel cells that convert energy more efficiently than power stations
- Coal burning power stations might be restricted due to CO2 emission
- Nuclear fusion power stations might make conventional power stations obsolete
- Geothermal district heating is already very common in Iceland. This technology has however also a great potential several places in Denmark

- District cooling could be an interesting alternative in hot areas. The Japan experiments has shown that water of about 9,5 °C is available all year at a depth of 300 meters also when the outside air temperature reach 35 °C.

LOCAL TAX

Reduced tax translates directly to higher prices on houses.

SITE PLANNING

Site planning tends to increase site value in several ways:

- Significantly reducing and monopolising site supply
- Providing public infra structure
- Providing public services at city centres
- Providing a guarantee for solar access to all buildings on the site

The risk of city planning is of course poor planning resulting in inappropriate restrictions on building materials and architecture.

"NO SITE" WILD CARD

Imagine a shipyard producing large buildings on a kind of assembly line indoor. A giant house boat or a cruise liner without propulsion. Such a product will overcome the problem of transportation size as the floating buildings can be delivered everywhere at coasts and rivers. The entire building is floated to anchoring position. Depending on local law it can either keep floating and thus be legal within the ship regulation or it could be position on the sea bed like offshore installations.

The floating building could be self sufficient with treatment of

- Waste
- Wastewater in an ecological recycling system.
- Collection of rain water

Production of energy from

- Fuel cells
- Photovoltaics
- Wave power
- Heat pumps

This product is truly global. Most people already live in cities at the coast so the market is enormous if the price and product is competitive. A lot of people also already live on house boats, for example in Amsterdam.

FINANCIAL BENEFIT

In general, financial factors in the construction industry have a lot to do with the development of society and little to do with the actual building.

AVERAGE INCOME

The value of a building is related to the average income of the target group. Increasing income means increasing prices of houses, even though the construction cost does not rise.

The only thing the construction sector can do about average income is to

- ***Increase productivity***
- ***Sell on a global market***

SUPPLY AND DEMAND

This price mechanism is known from collector's items rather than from consumer goods.

It is a result of houses and sites being a kind of monopoly. There are only a very limited number of houses on one given location. There are only a few thousand apartments to own in Copenhagen city.

If we could increase supply, for instance with buildings floating in the harbour, we could influence this monopoly.

INTEREST RATE

Most people in the Nordic countries use a very substantial part of their income to pay for their house. They actually tend to pay as much as they can possibly afford. As most people in the Nordic countries finance their buildings with a loan, the interest rate is very important to the building prices. Double interest rate means almost 30% reduced price because people cannot afford paying anything extra.

The interest rate is dictated by the market and regulated on EU level so we have no influence on that. But the financial sector is providing loans where the interest rate is transformed into a larger loan thus removing it from the short term budget and deducting it from your potential assets.

PAY BACK TIME

The financial sector has been very creative in increasing pay back time thus removing the back payment from your short term budget and deducting it from your future assets. This will of course only work if the financial investors believe that the value of your house will grow in the future.

A pay back time based on realistic evaluation of life time of the particular building would encourage more durable, healthy and sustainable buildings.

LEASING

Leasing is an interesting option. It is hard to explain why a used house is growing in value. Value growth is tied to the site rather than to the building. Why not own the site and lease the building. You might even save on property taxes.

Leasing only makes sense if the building is transportable. Companies like Temporent are leasing buildings to industries wanting more office space.

Leasing provides a realistic financial incentive for the development of value of the building.

Factory production means transportability and that opens a market for leased buildings on a self-owned site.

TAX, SUBSIDIES AND TAX DEDUCTION

Taxes reduce the amount available for buying houses and that tends to reduce the price level. Tax deduction has the opposite effect. Subsidies to new-build houses reduces the cost but not the prices as the prices are set by the market. Taxation and subsidies can be used to change behaviour like saving energy, water etc.

Taxation can change our consumption pattern.

DEMOGRAPHY

Increased life time of people will increase the demand for housing and buildings in general.
Every research indicates that we will live longer. This development will accelerate with new medical competencies:

- Gene therapy
- Stem cells

Older people need less area than families, but the tendency is that they keep their house.

Immigration will also increase demand. The Nordic countries except Sweden has a very restrictive immigration policy. The present good employment situation could lead to a growing interest in immigration increasing demand.

Solutions where people can stay in their houses and yet put part of their building on the market as a home for others have a great potential.

CONSTRUCTING BENEFIT

The productivity in the construction industry ran until recently far behind any other industry. More than 80 years ago, Henry Ford started to produce cars on assembly lines. This development has come to the construction industry in the Nordic Countries, particularly massively in Sweden, within the last 10 years. The remaining challenge is that houses built in a factory have a low score on quality-of-life and architectural value.

DEVELOPERS

Who are the agents driving the new business? What is their key role and who bridges the gap between producer and user? Usually we perceive the constructors and the craftsmen as the construction industry, but if we follow the profit, we should focus on the developers, the building component industry and the building material resellers. Particularly the developers make a high profit. Some of the developers (NCC; Skanska) are constructors and construction industry as well. The developers are brand builders with a good contact to the consumers.

The developer can play a key role in industrial construction:

- ***Including the responsibility for ordering and coordinating components adding up to a building***
- ***Including also the process of optimising configuration (design, legally, logistically etc.) since the user most likely only builds a few times in a lifetime***
- ***Including contact with building authorities. In a modular building system there is still cost for negotiations with local authorities, and need for lawyers. When you build a house the approval process takes several months. Imagine a process where a house product is approved once by central authorities rather than a local***
- ***Optimising real time production to minimise the risk of changing market demand***

Architects and engineers can be given a new kind of role in this context:

- ***To develop and plan the modular building system and visualise all its variations and possibilities***
- ***To assist the client in choosing the appropriate modular system combination, if the client so desires***

SERVICES

The construction industry usually only sell once to a customer. That is particularly strange as it costs a lot of money to get an order.

Why not create a relation to the customer. Why not keep selling or even lease products.

- ***Facility management taking care of the house, keeping it safe and sound***

- ***Updates to software in home automation***
- ***Hotline support for "do it yourself" maintenance and updates***
- ***Financials partners interest in a positive development of property value***

FACTORY PRODUCTION

The Nordic countries are leading in factory made houses. Particularly in Sweden the factory made houses have a 85% market share for small houses and a growing market share for large buildings through a number of quite large scale factory producers of houses:

- Bo Klok (Ikea & Skanska) producing large boxes completely finished from a factory producing apartment buildings. The developer branch of Skanska
- Open house (Obos) producing large boxes for apartment buildings for their developer parent company OBOS
- NCC Komplett producing flat finished elements for their own development parent company
- Smålandsvillan producing large boxes for small family houses for private consumers

These examples demonstrate that it is possible to produce inexpensive houses on factory with a large profit margin. Some of these factories have a 20-30% profit like the developers. Most of them are in fact developers building houses for their own in-house developer. The large buildings are all built for parent company developers. It is a complete in-house process. The small houses are built for private consumers or small local developers.

The key cost savings of these factory productions are:

- 30% savings on building materials and components due to direct delivery from component factory in large quantities (that is one good reasons for the limited choice)
- Same component interfaces in all productions making detailed drawing automatically and repetitive production trivial (that is another good reasons for the limited choice)
- Indoor production. NCC Komplett even has indoor production on site
- Good logistics, NCC Komplett even has closed trucks for protected transportation of elements
- Better quality control

The quantity discount could be achieved via a more flexible B2B basis and issue of details could be eased with more robots in the production.

The next big challenges are more consumer benefits:

- ***Better out of the box architecture***
- ***Mass customisation***
- ***20 year service agreement and warranty like Toyotas factory made houses in Japan***
- ***More robots in production***

EXTERNAL BUSINESS BARRIERS

The Nordic housing factories produce each some 500-1000 units a year. They produce mainly for the domestic market and occasionally for a Nordic market. The barriers are:

- Different architectural preferences in the different Nordic countries
- Different building codes

One way forward is mass customisation

- ***Opening the system for architectural design***
- ***Adapting to any European building code***

NEXT GENERATION FACTORY HOUSES

The house factories have for good reasons focused on production. They have focused on transformation of production methodology from the car industry to the construction industry. They are catching up with the pre-robot car industry and that is a major achievement. But they are still producing Fords T-model. They produce handmade houses indoor within a factory.

The next step is:

- ***The Citroen DS19 model, a beautifully designed house***
- ***The Citroen 2CV, a versatile no nonsense house***
- ***The Morris Mini Minor model, a compact house***
- ***The Renault Espace model, a Multi Purpose Vehicle***
- ***The Jaguar E type model, a sexy house***

FUTURE BUSINESS MODELS

So far the developers, for instance NCC in the NCC Komplett case, are just selling whatever the factory can produce. That will only work in a premature market. Next thing will be to develop the whole product design professionally like they do in the consumer goods industry:

1. Architects will have a new role as **user centred industrial designers** creating, configuring and sampling adaptable building systems for present and future users. The business offers to the customers will be based on the users' perception of benefit creation. User communities could provide exceptional feed back for development.
2. 5D digital models with an **identity between the objects in the model and components and products you can configure and order by e-business**. One stop shopping. Any architecture should be sampled from or be broken down into components made by robots in a factory or on site construction made by robots. And these robots should be able to produce any shape, detail and texture.
3. The difference between construction and montage is that the components fit together without gaps. You cannot build a house from components if they do not fit together. We need **interfaces**, geometrical interfaces as well as intelligent interfaces. We need to transform the intelligence and experience of craftsmanship into an industrially designed product and component.
4. The building should be designed with a **hierarchy** of construction shells based on lifetime expectancy: Site-Structure (load bearing) -Skin (envelope) -Service (installations) -Space (partitions) -Stuff (furniture). Components with shorter

lifetime expectancy should never be embedded in a component or shell with a longer lifetime.

5. Components (windows, HVAC, electrical, cupboards, partition walls etc) should be **Plug&Play**, easy to install, demount, reuse and recycle. These components should be based on production platforms with tested and proven cross section, interface and materials. All components and systems should be quality tested, with extended warranty and service contract. Most likely these standards will develop within alliances of suppliers.
6. Rooms with many installations (or all the installations in the house) like bathroom, kitchen, scullery and boiler room could be constructed in a factory and taken to the construction site in a **container module**. Even these modules should be composed from replaceable Plug&Play components
7. Rooms and buildings too large to be transported can be constructed on the building site by **in situ robots**. Even this construction should be in a design that allows container modules to be replaced and components to be Plug&Play. The design should provide opportunity for growth and change, either by exploiting void space within the envelope or by designed gates to extensions and additions.
8. A hundred years ago 160 million (10% of the world population) lived in cities. A few month ago 3200 million (50% of the world population) lived in cities. This 20 times increase (3% a year accumulated) is now adding 100 million people to the cities every year destroying farm land, polluting the environment and increasing the hours lost in commuting. Building autonomously **offshor**e could be a solution to both industrial production (ship yards) and conservation in larger coastal cities with high prices of land.
9. The business model should invite **all partners to benefit from a future growth** in value and to avoid the “hit and run” construction industry we are used to. Business models should increasingly focus on service, upgrades, updates, maintenance in order to reduce cost and environmental strain.
10. **Energy consumption should be minimised** for production of components, construction, logistics, heating, cooling, ventilation, lighting, appliances, IT and commuting by 3D robots, recyclable materials, insulation, daylight, heat recovery, natural and hybrid ventilation, photovoltaics, solar heating, heating and cooling storage, hydrogen and battery powered cars, reintegration of work and residential areas.

BENEFICIAL TECHNOLOGY

The physical building process is redefined within the information society context. A building becomes information multiplied with material. Information comes from the process of design. In the production phase the material is transformed into the building. Information dictates how. The building process has now become a ‘black box’ between the digital model and the user. The design process is the human part, the creative, sensual part of the process. When completed, one has merely to press ‘build’ and the digital model is automatically sent, payment demanded and confirmed within the blink of an eye. Your dream has been translated into a living reality you can soon enter and use.

A paradigm-shift from the linear to the interactive, means that the square and cubicle will suddenly be obsolete. Architecture will metamorphose just as when a car developed from a horse carriage. It is no longer necessary to be limited to build in x and y directions because that was what could be drawn on a flat paper. Gehry’s contribution to architecture is using models and computers to break away from linearity. Hate it or love it, he has shown it is possible to use human creativity and the computer as concurrent means to an end. Visit the Guggenheim museum of modern art in Bilbao and try to deny that your senses are stimulated.

The building process will become totally automatic. Modules will be produced through robot technology as we see in the car industry, only more agile and customised. Sliced as we know from the textile industry, and printed from the three-dimensional printer as we know from rapid prototyping. Virtual, agile mass customised manufacturing has come of age.

The important difference between buildings and other automatically produced industrial products are their size and thus the difficulty of transporting them to their particular site.

If we design with a continuous rather than discontinuous shape virtually all of those difficult, expensive and troublesome details between the junctions of the building disappear, except of course where transportation demands slicing in smaller modules.

A sustainable house should also be able to expand and contract. Be added to and have taken away. Even be transported from one place to the next. And be taken apart and reused.

- ***The success of LEGO and jig saw puzzles is based on a simple interface. A geometrical relationship joining one brick to another.***
- ***Interface in the building industry is also the key to utilising new technology that contributes to a dynamic and creative existence.***
- ***If we follow the lead of LEGO, we could build without special training or tools, because the necessary knowledgeis designed into the product. We have merely to use our creativity.***

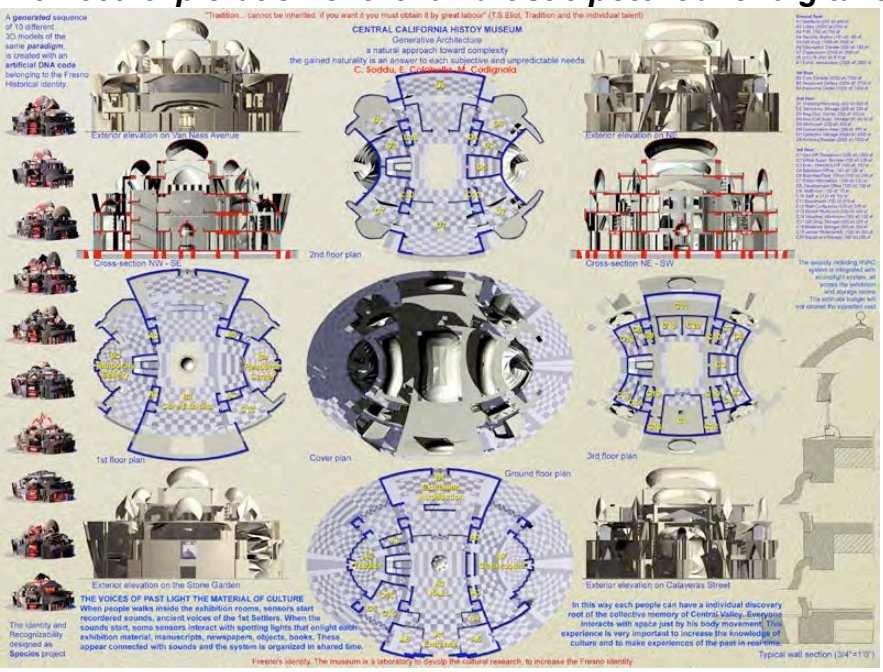
NEW DESIGN

Drawing a building is only one way of designing. For many years, CAD was a discipline of technicians transferring the sketches from the master architect into a digital form. But that was only the beginning. Now some architects master CAD and can start to explore the full potential of digital design.

Design tools like Gehrytechnologies and Bentleys generative are truly 3D, not just raised 2D.

- Object based design, composing the building from actual components downloaded and ordered from the Internet
- Standardised component interfaces connect the objects Plug&Play both in model and real world
- 5D takes the true 3D CAD into animation movies simulating the production process in time, deliverables and money
- Augmented reality shows the 5D model superimposed on the real world
- The illustration below shows a design generated automatically by a computer based on design rules and principles. This way the architect is rather a judge than a designer
- You could also use sampling of 3D scanned objects from historic building, plants, animals, art etc. and compose them into a building

We need exploration of the full artistic potential of digital design.



USER SAMPLED DESIGN

So far users seem to be worse designers than the building industry. Even though we all have experience with a house it is not trivial to create good architecture.

DELL is famous for its configuration system. It is however difficult for many customers to choose among the many highly technical options. But buildings are a hundred times more complex. If we ask people to make all those choices they get lost. If we limit the choices, we are back to NCC Komplett.

An innovative solution could be a kind of "20 questions to the professor game" where the user is choosing preferences, sampling and closing in on a design based on preferences. An expert system, a 3D Google could support this search. This way the image of the new house could emerge evolutionary guided by an architectural expert or an ICT expert system preventing solutions that do not fulfil building regulations and functional demands. Such a process is radically different from both the DELL menu choice, and the traditional drawing process.

DESIGN AND PRODUCTION CONCEPT

There are several competing mindsets for digital modelling and construction:

- Keeping the entire model in-house like NCC Komplett
- An open source model adding modular components ordered from the internet until they add up to a complete house
- A kind a docking-station concept where you add entire prefab rooms, even stacked on shelves (like Open house)
- A kind of New York loft model where you build a void space, a store room, and fill it with highly adaptable modular self assembly Plug&Play furniture like partition elements, bathroom units
- A holistic approach where you design whatever shapes you want and slice the design in units transportable within the 40 feet container volume
- On site production with robots

The holistic slicing concept is fascinating because the design is no longer dictated by the production. You can produce with a milling robot that does not care whatever design you chose. Just go ahead.

RAPID MANUFACTURING

Most buildings are one of a kind. Prototypes. Why not build with a giant 3D printer. It would make the construction business obsolete. You just click "build" and off the robot goes building. Sounds like science fiction but is never the less reality in several industries.

- 5 axis milling is used in boat and windmill industry on objects up to 52 m ! You could use insulation material as a core, mill it to whatever shape you want and cover it with a thin layer of fibre reinforced shotcrete. Such a construction would be wind and water proof, highly insulated, completely without thermal bridges, use a minimum of material, recycle all waste, be light and transportable but not really recyclable?
- Membrane supported constructions -monolithic domes- are used in the US. You blow up a membrane, cover the inside with foam insulation and cover the insulation with shotcrete. The benefits are as above, except that you can only choose tent like shapes that can be shaped in the membrane and supported by air pressure
- Contour crafting is a technology known from pottery. A robot adds concrete material like toothpaste layer by layer. The limitation is that decks and beams over windows and doors must be supported
- Components can be made in a large 3D printer

Rapid manufacturing is spreading like a wildfire in the small volume of around 0.05 m3. We need to take the technology to building size or at

least to be able to make components the size of a 40 foot container (se slicing above).

HUMANOID ROBOTS

Honda and Toyota already have humanoid robot prototypes in service. They can “see” and react to what they see. They can walk around and climb stairs without falling. They can mimic and learn movements, shake hands, dance and run.

The present human process of building could be mimicked by robots however without mistakes and errors.

3D SCANNING

3D laser scanners are already experimentally used to scan nodes on a cast concrete construction. The real life coordinates are fed into a parametric 3D digital model of the building and the dimensions of the components to fit the concrete constructions are ordered with the correct dimensions.

The scanning technology will have a large potential in reconstructions and retrofits.

RFID

RFID is a small digital tag that can be built into (building) components. You can store all kinds of information on this tag and the tag at this information could link to web-pages and manuals as well as building maintenance systems.

RFID tags can be read by some cell phones.

The potential of RFID is in

- ***Logistics***
- ***Accounting***
- ***Maintenance***
- ***And as a tool for robots recognition of components***

NANO TECHNOLOGY

Nano technology is entering the market:

- Nano paintings repairing scratches
- Nano surfaces making them non stick and self cleaning
- Nano fibres adding strength
- Nano semiconducters and light emitting material
- Nano surfaces producing photo electricity
- Nano manipulation of molecules in materials, for instance concrete
- Smart textiles

Nano technology hold great promises but also significant risk. We already know that nano carbon particles from diesel engines provide a health risk. Houses last a long time, we are very exposed to materials in buildings, and materials are often difficult to remove. So to avoid a new asbestos scandal we should perform thorough tests on health issues before implementing nano in buildings.

ICELANDIC WORKSHOP

Reykjavik, November 20th 2006

The Icelandic workshop focused on the specific Icelandic dimension to the challenge:
Buildings supporting personal development and enhancing quality of life.

The impression was that most people focused their social life on relatives and friends while the more casual meeting with neighbours and strangers are limited by the weather. Compared to warmer climates there is no place to meet, little street life, no gardens, few outdoor cafés etc. Actually the candy shops have become the social meeting points for kids.

One specific challenge to cold climates including north of Norway, Sweden and Finland could be to construct semi-climatic areas between the houses. This is particularly attractive in Iceland where volcanic heat is plentiful, and there are no trees for natural protection.

Another specific challenge is the limited natural daylight in the winter. This challenge is also shared with other high north areas. Large south and southwest facing windows are getting more popular in Icelandic architecture, but also roof windows could be useful, particular as Iceland is often covered by clouds blocking direct sunlight. The tendency is however to built multi story buildings where roof lights are only possible on top floors and (glazed) balconies. Glazed balconies are yet strangely unusual in Iceland.

Balconies are very popular and they are used for sunbathing and BarBQ whenever possible (temperature above 10 centigrade).

Iceland has a long history of buildings made from stone and with grass on the roof. There is however little other architectural tradition. Iceland was very poor when modern building technology was introduced and that lead to extended use of corrugated steel plate in many bright colours for roofs and walls. Nowadays the colours are more like the surrounding landscape: White and gray.

Like in other Nordic countries, Iceland has a strong tradition for building codes and town planning regulating the architecture and design of buildings. Particularly the town planning regulations could limit development of new architecture.

Iceland is blessed with plenty of water and especially plenty of hot water. There is already a growing offering of volcanic heated spa bath and one of Iceland's tourist attractions is the thermal pool at "Blue lagoon". This could be an Icelandic dimension to future architecture.

Icelandic families owns a growing number of cars, snow scooters, and stuff making the garage the fast growing area of the buildings.

Among the paradoxes of Iceland architecture is that:

- Houses are built of timber even though there is no forest
- Plenty of space yet houses are built several floors high

Why is the natural material on Iceland, volcanic stone, not used (in fact it is at the Blue Lagoon building).

Among the interesting potentials are:

- Working with the indoor-outdoor relation
- Bringing the nature into the architecture instead of isolating from it
- Unique humour

The issue of expressing yourself through architecture and indoor architecture was debated. One of the interesting views was expression. A very personal storytelling is for interior only as self expression in the exterior would be too exhibitive. Your personal history is private

Of course, building indoor or at a factory is even more important in artic weather conditions.

FINLANDIC WORKSHOP

Helsinki, November 23rd 2006

TYPICAL FINISH

Finish life

- Always warm, that is, well insulated and heated when necessary
- The inside of the house counts much more that the outside
- It is dark outside and we live 90% of the time inside
- No shoes indoor

Do it yourself

- People want to build their own houses
- “Handy man”
- People want their own house
- Made by amateurs or homemade by professionals
- The house shows what you are like

Sauna

- Sauna, a place to relax and talk
- Cell phone controlled sauna and heating
- Always on sauna is a type of heater which saves actually energy if you often go to sauna
- Beach side sauna

Construction

- Climate demand energy efficient houses
- Utilising natural raw materials, particularly wood
- Airtight
- Roof overhang
- No bugs in houses
- Triple glazing
- District heating
- Wooden floor
- In Finland ventilation with heat recovery is mandatory in new houses

High tech

- A lot of high tech in homes using a lot of energy
- Pour energy consciousness
- ICT
- Wireless

Design

- Finish homes are marketed on nr. of bedrooms rather than m2

- Small bedrooms and small apartments

Back to nature

- Apple trees
- Much space around building, low density
- Summer cottages right next to one of the 180.000 lakes
- Summer cottages completely without technology

Fireplace and heating

- Special room for fireplace
- Fireplace storing heat
- Fireplace being peak demand heating
- Fireplace could mean difference between life and death when it is cold
- Fireplace is comfortable luxury
- BarBQ fireplace

Water

- Thermostat water tabs
- Hot shower is really hot in Finland
- Plenty water

HOUSE OF TOMORROW

Flexibility

- Flexible to adapt
- Convertible interior
- For different residents, age and needs
- For different use like parties
- Taking the favourite wall with you to the next house
- Use the 3rd dimension for lifting things up
- Living in different heights

Technology

- Planning First
- Move the systems outside the house
- Systems with several functionalities
- Intelligently surfaces changing temperature, light etc.
- Casino in central Helsinki changing colour
- Use genuine materials instead of fake
- Users should be able to operate new technology intuitively without instructions
- Playstation simplicity
- The house should understand you
- Always on
- Switch where you turn natural light on
- Multi functionality – “Swiss army knife”
- Self fixing house
- Take the technology out of the house

- District everything (district beer)
- Less expensive house to provide economy for living

Design

- Round shapes tells beautifully about the light
- Colours, more bright colours instead of all the white
- Maslow pyramid
- Water (fountains, basins) – fire (fireplace) – natural daylight
- Play with water inside the house
- Fruit trees indoor
- Hand made – home made – self made
- Users being in control
- Rather an inexpensive building envelope and a handmade interior
- People should design their own houses
- Houses should be sexy and relaxing
- Appearance is everything
- Beauty is the not the same for everybody
- A house should look like the owners
- The house should tell who you are
- Multi functionality – “Swiss army knife”

Privacy

- Personal acoustic environment
- Privacy in order to be able to be alone or private together
- Peace and calmness and close to nature
- Security
- Safety

Process

- Demand, need, desires => dreams => reality

NORWEGIAN WORKSHOP

Trondheim, Norway, January 16th 2007

Typical Norwegian

- Independence, everybody has everything in their own family
- Own house
- Owner of the house
- Controlling their home, view and surroundings
- Avoiding influence from neighbours
- Building a home is a test of manhood
- House is a long term capital investment
- The local countryside community is alive and well
- Norwegians fight centralisation

Cosiness

- Norwegians are individualists who wants to be cosy in their home
- Cosiness is tight related to family, it is almost infidelity to be cosy outside the family
- The family is THE social relation, substituting male and female communities
- Family is a kind of “dark hole” attracting all social life
- Family is pretending unity and agreement
- A cosy living room has pictures of the forth, reindeers and souvenirs
- Fireplace is cosiness
- The mountain cottage is a cosy house
- Small windows with many frames
- Ling room is the centre of cosiness
- Home is immaterial history
- Architects reject to design cosiness

Social life

- Oslo has twice as many cafés as Copenhagen
- Norwegians sit at café, one at each table, without talking
- In Norway it is OK to be silent when together
- Café is social life without obligations
- “Dugdag” is a tradition for neighbours helping each other building common facilities
- The only acceptable reason to leave the family is to do some good for the community
- A lot of activity in sport organisation
- Public non commercial spaces are rare

Nature

- Scattered building, plenty of space, no city limits
- Norwegians love nature and most Norwegians have rooms with a view to forth and mountains

- Many has fishing and hunting as their hobby
- Everybody has access to the nature, also on private property
- Nature is visible within the house through panorama windows unless somebody can look into your house
- South facing terrace
- BBQ in the garden
- Natural materials like raw wood and stone
- Wood panels in concrete buildings
- Plants
- But also blasting roads through the terrain

Technology

- Norwegians buy load of things. Most of it end up in the attic store
- High technology is high status
- People exhibit their “best in test” gadgets and consumer goods
- Burglar alarms
- Manuals are needed to understand home automation
- We need a house people can understand
- Automation without need for helpdesk
- Minimal energy consumption
- Need for “no nonsense” approach. Which technology provides true benefits

Concepts

- Natural house in symbiosis with nature
- Building as “experience economy”
- I-house like I-pod, high profile design in minimal dimensions
- From book shelves to multimedia
- Multi Purpose Vehicle interior
- Healthy house
- Buildings you can bring along
- Flexibility in construction
- Flexibility ever after in the interior
- Creating more with less

Trends

- Norwegians move permanently to vacation houses in the mountains and have an emergency apartment near their job
- Either nature house or city jungle
- Fight for attention
- Something disruptive is needed to solve environmental problems
- Environmental need for “back to basics”
- Buildings as brands, fashion, sex
- Brands are limiting freedom?
- Low tech house because high tech goes obsolete too fast

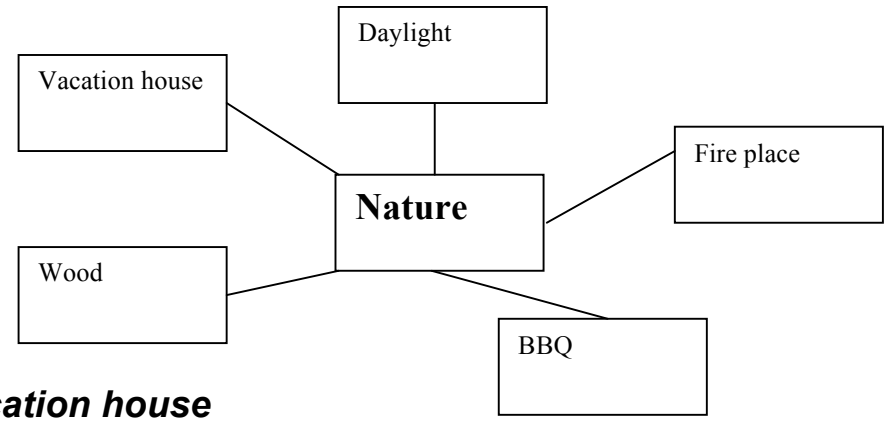
DANISH WORKSHOP

Herning, Denmark, January 22nd 2007

Based on the results from the other Nordic workshops this workshop had 6 themes:

1. Vacation house
2. Fire place
3. Wood
4. Nature
5. Daylight
6. BBQ

Maybe these themes could be structured around “nature”:



Vacation house

- Contrast between high tech work life and “hunters-gatherer” vacation life
- Also vacation houses with more luxury and wellness than ordinary houses
- Living with nature or symbol of wealth
- Why not make your home your vacation house

Fire place

- Power
- Radiant heating
- Flames
- “Hunters-Gatherer” fire
- Chosen cosiness
- The dream about the things we are too busy to do

Wood

- Warm and soft to touch
- Easy to shape
- Recyclable and burnable
- Raw natural materials
- Patina, structure, variation, un-perfect
- Viking buildings
- Ask Ydgrasil, tree of life at the centre of the Viking world

But also rot, fire hazard.

Nature

- Genuine, honest
- Changing seasons
- Green plants
- View
- Recreation
- Sport
- Gardens
- Surroundings
- Weather

Daylight

- Daylight is particularly important in the Nordic countries because it is so scarce in winter
- There is no daylight when you are home at workdays in the winter sp daylight is particularly important in work space
- Light provides energy, also for us humans
- Light creates colours
- Light creates focus
- Houses with large windows are like aquariums for exhibitionists
- Solarium light
- Shadows
- Kites
- Devine light
- Reflectors focusing light to the interior

BBQ

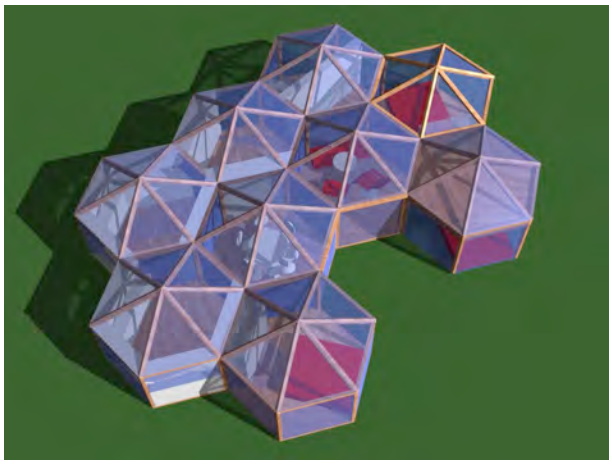
- “Hunter-Gatherer” men cooking
- Primitive, natural
- A taste of smoke and fire
- Getting together
- Informal, slow food, tolerant

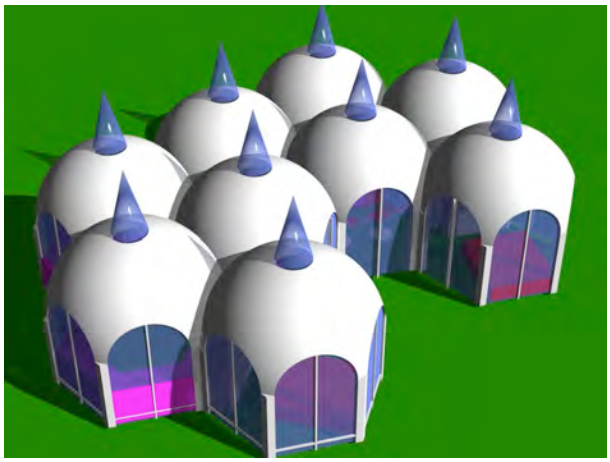
Ideas from the workshop

- Seasonal rooms with changing climate
- Wellness, feel good, room
- Composition of many different (natural) materials
- Interpretational rooms, materials and shapes
- Variations
- Being almost outdoor
- Layers filtering between indoor and outdoor
- Sensual, sensitive, tactile rooms and materials
- Overcoat, minimal surface, energy saving or energy producing
- House within a glass house
- Basic room

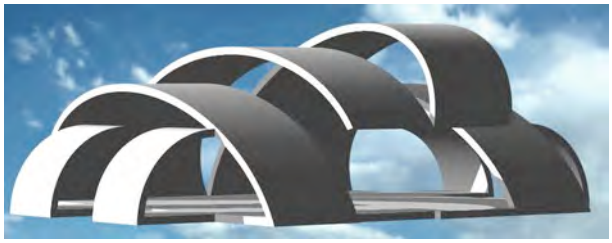
- Adaptable and renewable building envelopes
- Improved indoor climate
- Sustainability, renewable energy and energy conservation

THE STORY ABOUT VILLALIVE

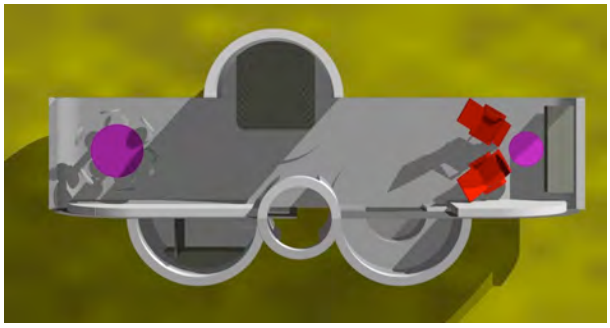


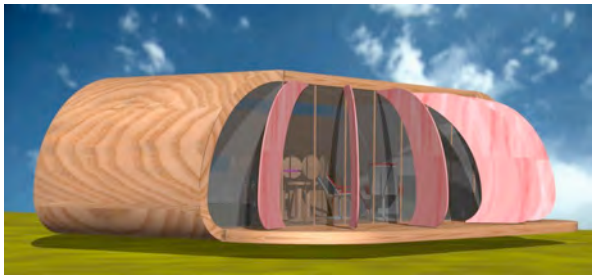


This is a very early sketch of additive hexagon modules adding up to a house. The modules can be moved, exchanged and replaced by similar format modules with different functionality. The two illustrations have same dimensions but obviously different appearance

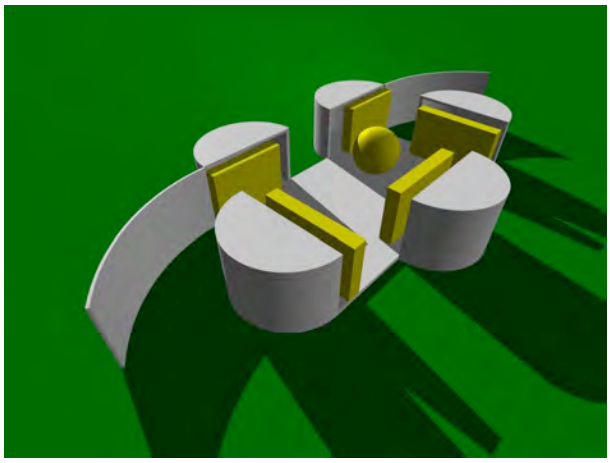


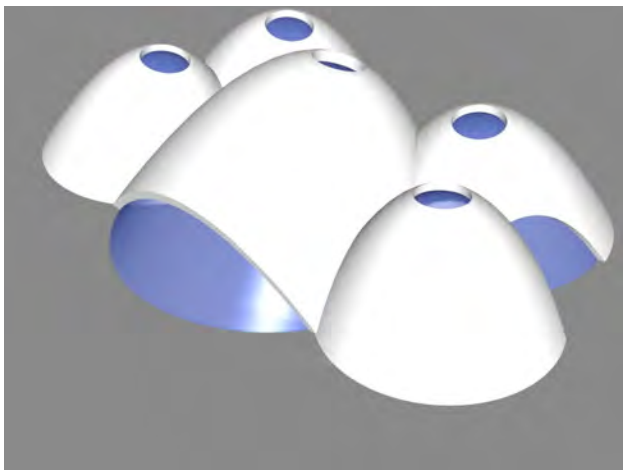
Folding the roof instead of the walls

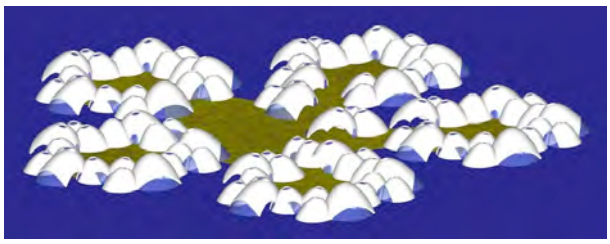


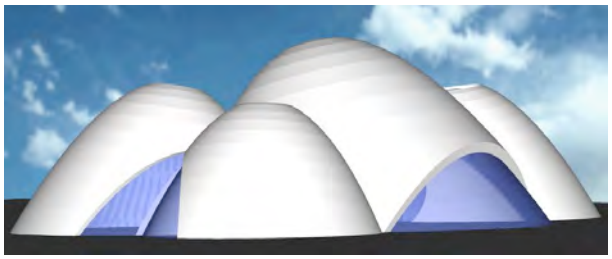


Container house with rooms that expands with units turning out of the box

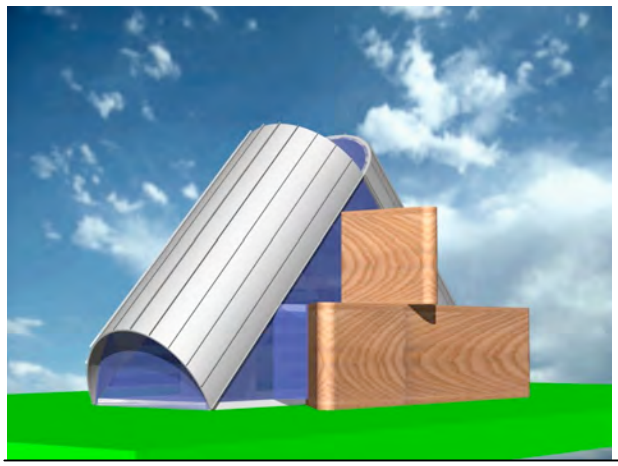






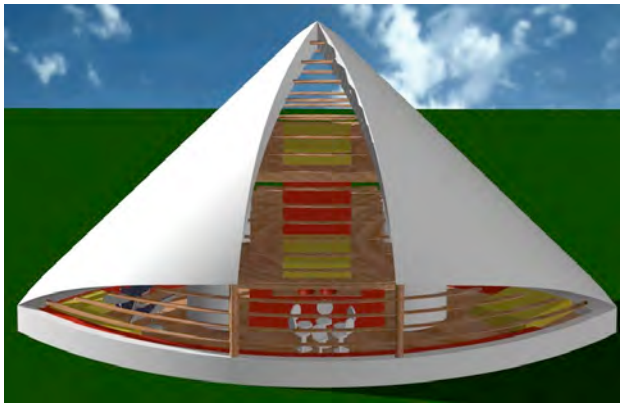


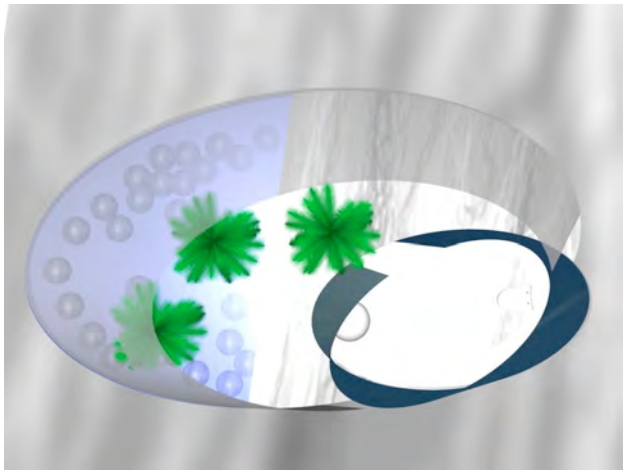
This shape is created by an inflated membrane covered with insulation foam and fibre reinforced shotcrete
The principle is called Monolithic Domes

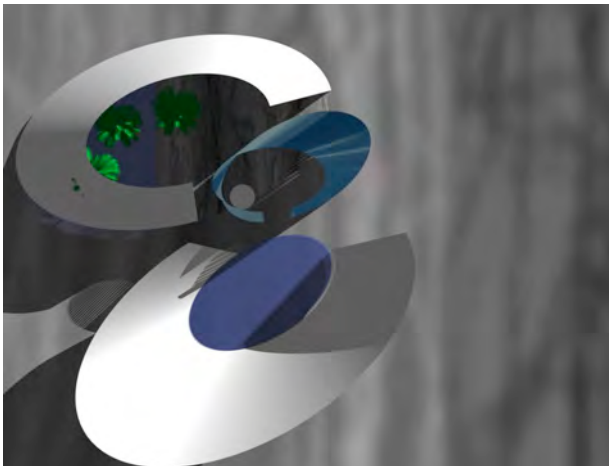


Unfolding half cylinder containers roofing a building

And a later version of the same idea

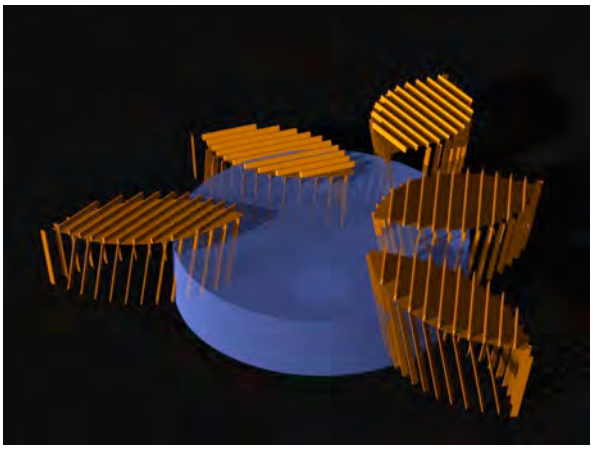


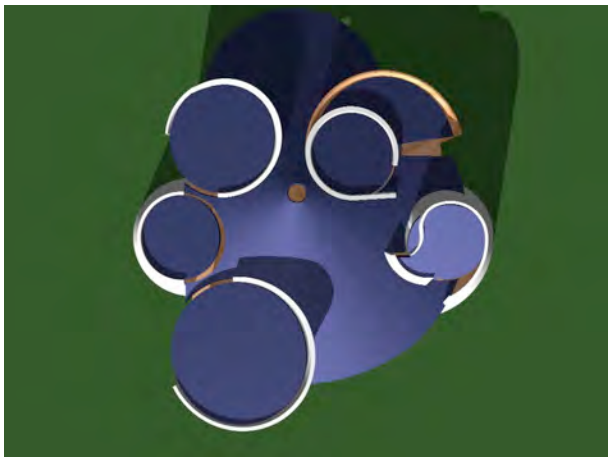




This design for the exhibition bathroom for “Boligdrømme” 2006 came too late

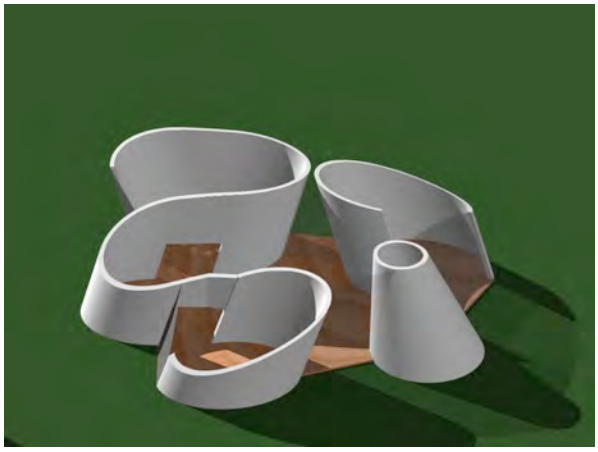
Clustered layout of curved transportable modules, but before Serra

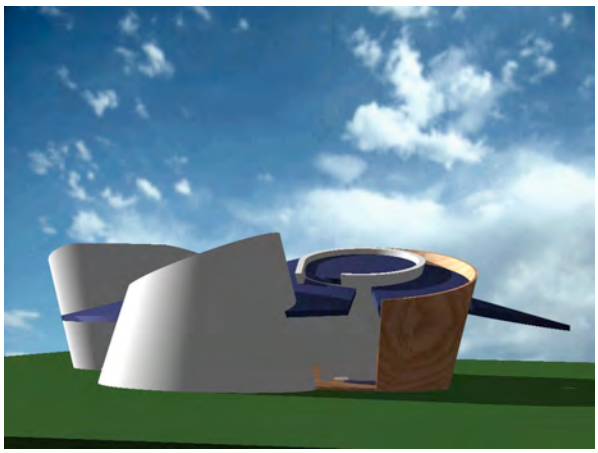


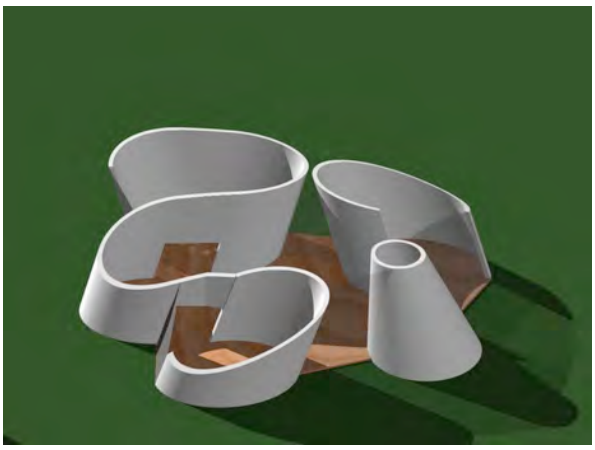


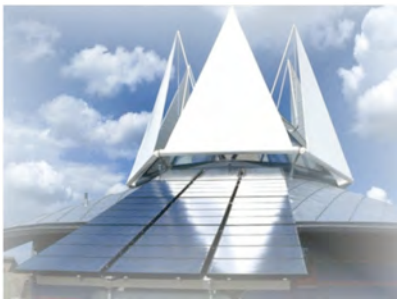
Curved design in an early stage

Serra shapes but before it became transportable modules

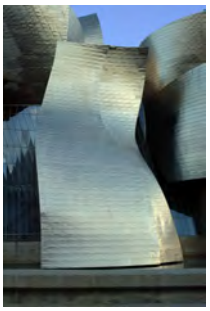




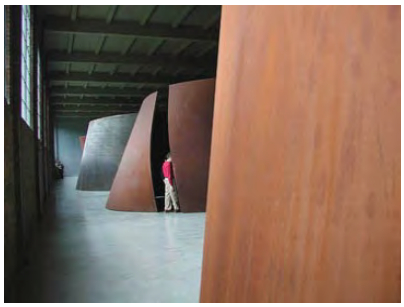




Villa VISION



Guggenheim



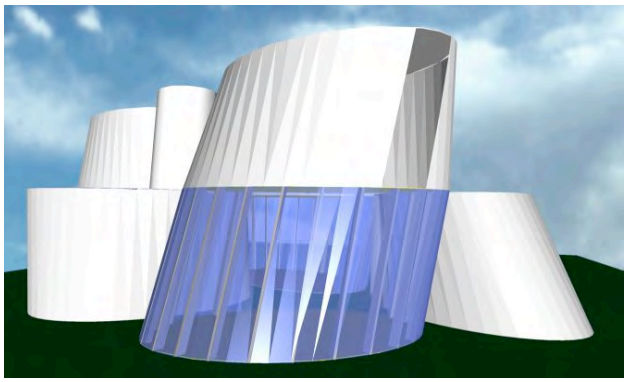
Richar Serra sculptures

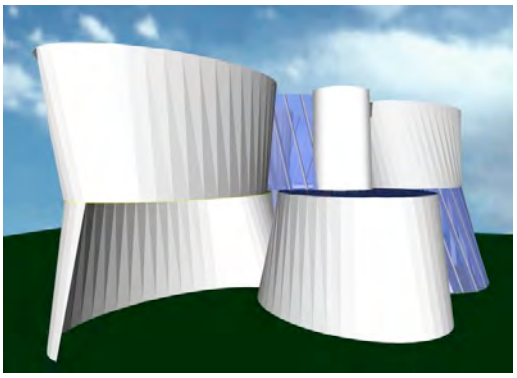
A STORY ABOUT PIONEERING AND ENTHUSIASM

It´s hard to tell where it started. Maybe the DNA is from villaVISION (above), the experimental house Flemming Skude and I designed and build at Danish Technological Institute (DTI) together with almost a hundred industries and partners back in 1994, or maybe from exhibitions versions of villaVISION back in 1992 and 1993. Anyway, when Herning Messecenter approached us at DTI December 2004 with the challenge to design an iconic exhibition building for the reintroduced BUILD 07, we knew we could do it, but we didn't have a clue how.

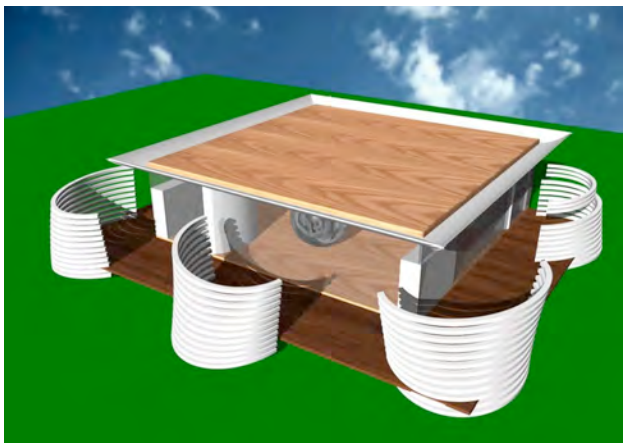
I the following year we made dozens of different designs (previous pages) and flooded mailboxes with 3D renderings. But there was no really promising design until I in the summer 2005 visited Frank Gehry's Guggenheim museum in Bilbao (above). I was like a pilgrim approaching Mekka, and the museum was even more amazing than I had hoped for. But even so, it was the exhibition in the south wing with sculptures by Richard Serra (above) that became the true inspiration for villAlive. As a student I worked at a shipyard, so I knew that the very thick steel plates of Serra was singled curved and thus much more easy to build than the double curved shapes in the Guggenheim building. Serra folds steel while we twist boards in villAlive so our shapes actually become a little double curved adding "spice" to the experience. I was on holiday in Spain, and the first designs were made by pressing paper into the sand of the Costa Brava beach to support the curved figures, later followed by some more solid models and a lot of computer models and renderings. A significant step forward was when Flemming gave me a book describing the geometry of Serra's figures.

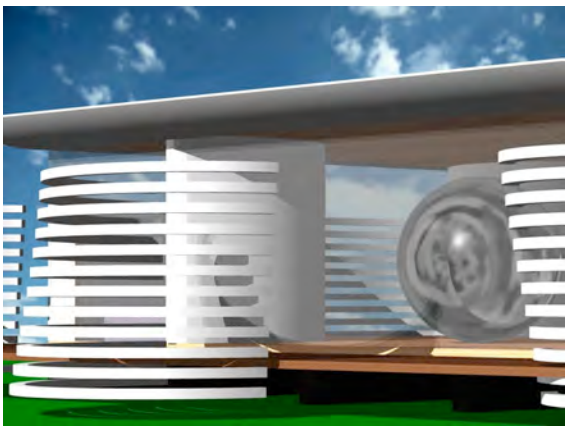
In the meantime we applied Nordic Innovation Center (NICe) for support to the quest and in June 2006 NICe funded us and we had the first memorable meeting in Iceland. It certainly wasn't the 24 hours cloudy diffuse daylight that enlightened us. But gathering so many creative people trying to define success criteria for buildings of the future was a magnificent moment. And among the many contributions were two particularly interesting: Torben Thyregods distinction between house and home and Esa Nykanen coined the success criteria "Better every morning", explaining that every day you wake up your first thought is: "I am even more happy for my house today".



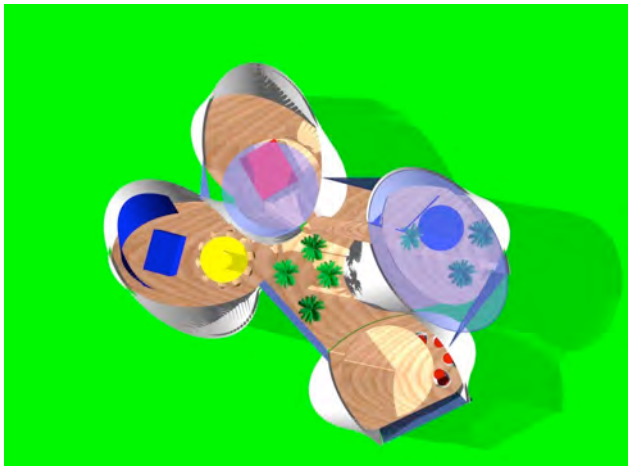


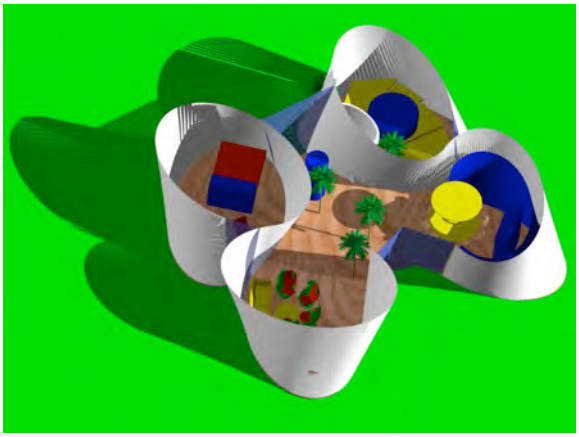
The first box modules inspired from Serra's torqued ellipses



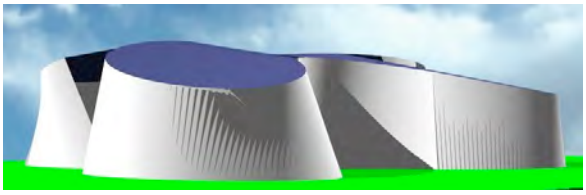


Adding fences to a glass box to creating Serra spaces





Approved design before Christmas
Notice that the computer generates wood boards in the renderings



That became the yardstick of villAlive, and when Esa 9 month later saw villAlive he coined a new ambition “Happier or money back” focusing on what houses do to people.

After the second workshop in Copenhagen in September 2006 about business models it was harder to see convergence. Should we find the solution on component level, or in room size modules or with a 3D printer or what? The arguments for each solution were overwhelming, yet not conclusive. We didn’t make it to the “Boligdrømme for alle” exhibition in Herning because we didn’t know what to exhibit.

In the meantime we were almost running out of time for the next exhibition as well. We had an emergency meeting with Lars Jespersen and Charlotte Hedegaard from Herning Messecenter and asked them to decide. They came back with the creative idea to make an exhibition building to be used for 3 different exhibitions. That was truly adaptable. That limited the choices to room size module designs and they chose fortunately the best concept. The most important in any innovative building processes is a good client, and Herning Messecenter is the ideal client for such a project. They simply wanted an icon, and they got one.

The moment of truth was a meeting in Herning where Eli Sahlholdt, heading the construction team at Herning Messecenter, saw the project for the first time. He was the one to be responsible for building a house with a construction nobody, not even Serra, had ever tried before, within a limited budget and with an ultimate deadline at the exhibition in April four month later. I was nervous that he would say: “Impossible”. So the day and night before we drove to the meeting I built a small model shoving that it was possible. Well actually I didn’t know myself until I had build the model. The model was inspired by the wire frame visualisation used in the design mode in the CAD software. The wireframes suggested that it was possible to use standard wood boards. And it was, at least in the model. Eli is an unusually open minded person and he looked at the model, turned it in his hands and said “Well, that doesn’t seem harder than building the wooden indoor bicycle racetracks”. That was the moment villAlive became reality.

To be completely convinced -however- Eli went back to Svend Post, the carpenter who was contracting the construction. Svend made a larger and much more accurate model and came back with two worries: Can we lift the module with a forklift, and can we twist the boards 50 degrees? Eli and Svend chose to integrate a strong and heavy steel beams in the floor. A solution we have been very happy with. And they carefully selected a twistable thickness of the boards

In the meantime we continued the Adaptable house project with a very fruitful technical workshop in Helsinki. We visited a factory in Piikkio that has already produced 60.000+ room size modules, and we added it to the long list of possibilities and success criteria. I knew that the entire group would never agree on one specific house design, so advised by my mentor Torben Thyregod at VELUX, we split the project up in a generic report and a specific exhibition house.

The way we built the model was an inspiration for the way we constructed the building modules

We started with floor and roof. A disruptive concept, and we kept floor and roof apart during the montage of wood boards.

And we cut the wood board after montage

We continued with the public workshops in Iceland and Finland and were inspired to improve the design. Flemming and I worked nights and days on the design, and decided to have two parallel design processes. We designed the modules a little ahead of the house, because Eli and Svend needed dimensions for the modules in order to start construction.

The next moment of truth was construction of the first module. We knew that we could build the model, but what about the full scale module. I had learned from my first lousy model that we needed to start with the floor and the roof. We lifted the floor level enough to be able to cut the boards along the bottom of the floor. The elliptical floor shape can be drafted from the distance between two nails and the length of a string attached to both. That is 2 numbers of information. Then we build a tower to carry the identical dimension roof. The towers horizontal dimensions were the dimensions of a standard plywood plate. So that is not even a number. The height of the low columns and the high columns are 2 additional numbers. The angle the tower is rotated relative to both floor and roof is the remaining 2 numbers, or actually only one number with a plus and one with a minus. So all together 5 numbers were necessary. 0.000005MB.

We made one conventional 2D drawing of the house. The rest of the documentation was renderings. The 2D drawings are useless in double curved houses. So we just forgot about it. Nobody at the site had computer software to read 3D, in fact there was no computer at the site. I think that meant a lot.

- Renderings communicates what we want it to look like but not the exact dimensions while most drawing communicate dimensions without visualisation.
- When the craftsmen needed dimensions they could choose where to measure and I could deliver the any dimensions on request.
- Communication was more via digital pictures keeping focus on the visual aspects

These experiences are very valuable because the authorities and everybody in the construction industry is focused on 3D in the design phase while they seem to have overlooked that there is nobody out there who can read 3D.

The breathtaking moment was when we screwed the first boards on the construction. We were concerned that the 50 degrees twisted boards would twist the entire roof. So we used two screws at both ends of the board and glued the boards together. But only 10 boards in a row to control cracks if the boards dried. (And they did dry). When we had put up the first 15 boards (10%) I was sure it would work and drove back to Copenhagen. Well almost sure. I called half way back and Svend comforted me that it did indeed work.

Roof above and floor at right was made as ellipses

A forklift lifted the roof on top op the re-usable montage tower

The first boards fixed the position

Board at screwed and glued to floor and roof

They are cut after montage at both floor and roof

Test drive

We didn't know how stable the volume was and wanted to make a test drive before we build the next 3 modules. And the test drive was fortunately successful. Eli and Svend had put steel bars in the floor and everything went perfect. While the next modules were constructed, Flemming and I went back and redesigned the entire house except the modules. The good advice is of course: "Don't ever change the design during the building phase", and we were of course afraid that somebody in Herning would be unhappy with that, - after all it was 3 weeks before the invited presentation - but the new design was so much better that everybody was in fact happy. It was giving me a kind of split personality to work with innovation of the construction process advocating more planning, systems and automation yet experiencing that we improvised and couldn't do without the brains and talent of the craftsmen. My conclusion is that we need to connect the design and construction as much and closely as possible. Either by designing together with the craftsmen, or by designing digitally and build with robots.

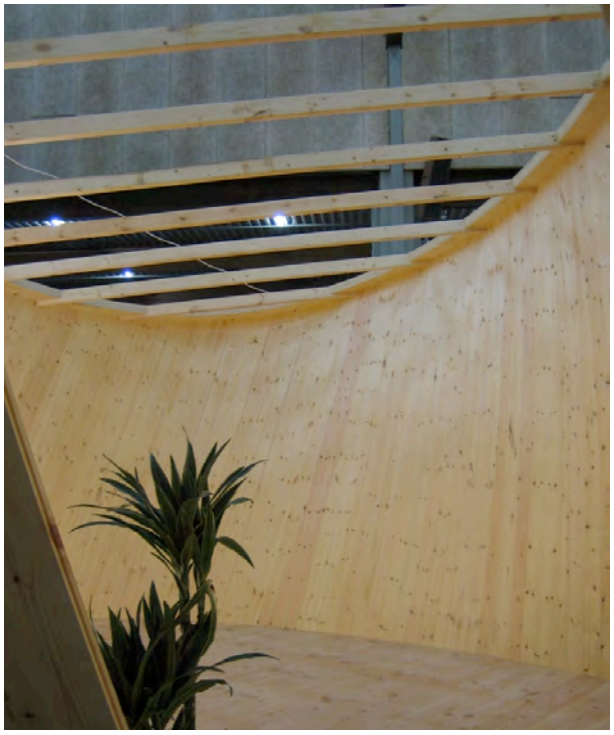
After an inspiring "Adaptable house" workshop in Norway with fruitful workshops also with Annemie and her architecture students in mid January, Flemming and I went to Herning and the team put the modules together and had to finish with the roof. There was a few days left to the presentation where we had invited a lot of building industry partners to see the house. We had even arranged the Danish "Adaptable house" workshop at the same presentation. And yet we didn't know exactly how to build the roof between the modules. The challenge was that it should be detached and moved just like the modules. We decided to make a flexible soft roof, so soft that it would align with the many different curved roofs. And it was beautiful. It happened to look like a giant bird wing.

It was a happy day when we opened the doors for our guests and learned that they loved the house. The first plan was to exhibit the plain wood mock up at BYG 07, but after the warm feed back in the rather chill construction hall Lars and I decided to go for it. Let's build the house in April for BYG 07. We asked all the guests if they would participate and most of them would. There were actually too many industries for the walls so we ended up with both Rheinzink and Icopal on one wall.

In hindsight it sounds like it was easy but it wasn't. In fact it was a little like these indoor bicycle races. The first rounds are very slow, and then suddenly everybody starts driving like crazy. The first 3-4 weeks after the presentation in Herning very little happened. Everybody was considering which is only natural. But time was running. We had put a deadline around March first and fortunately commitment suddenly came in large numbers. At that time we had 6 weeks to go and one of them was Easter holiday. And we had the problem that we had to redesign a lot of things to fit the sponsors and that we had to do it NOW!

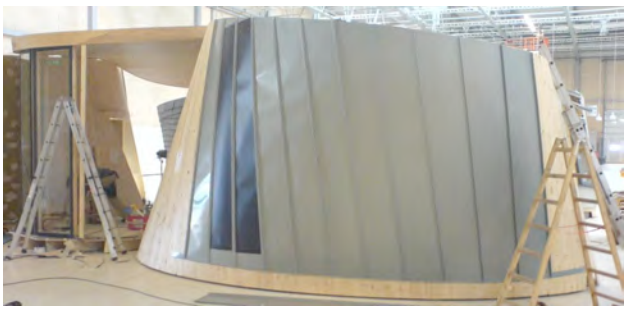
Experimenting with the “soft” roof construction

MMS from Morten used in the long distance communication during the building process



In January we did not know who would supply roof windows. So these openings were cut just to experiment with light. I liked that design, but we could not build it with the available roof window products.

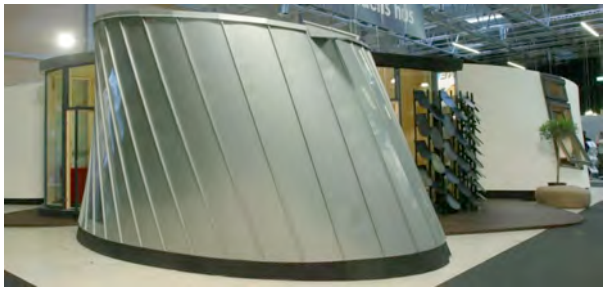
The square Rockwool batts could be curved around the wooden shapes



Parallel zink rolls bend around the curved shape
Shingles were used for shading the glass and Icopal showed their new roof material between the windows and the zinc cladding

The plastered surface is amazingly smooth at the white colour enhances the shape when it by sunlight.

The two sides of the shingle module happened to be clad in two different ways. The left picture shows shingles laid out like the wood boards and the right like you would do if it was not curved. Both are beautiful



Beautiful zinc details

That period was actually more stressing than the days before the exhibition.

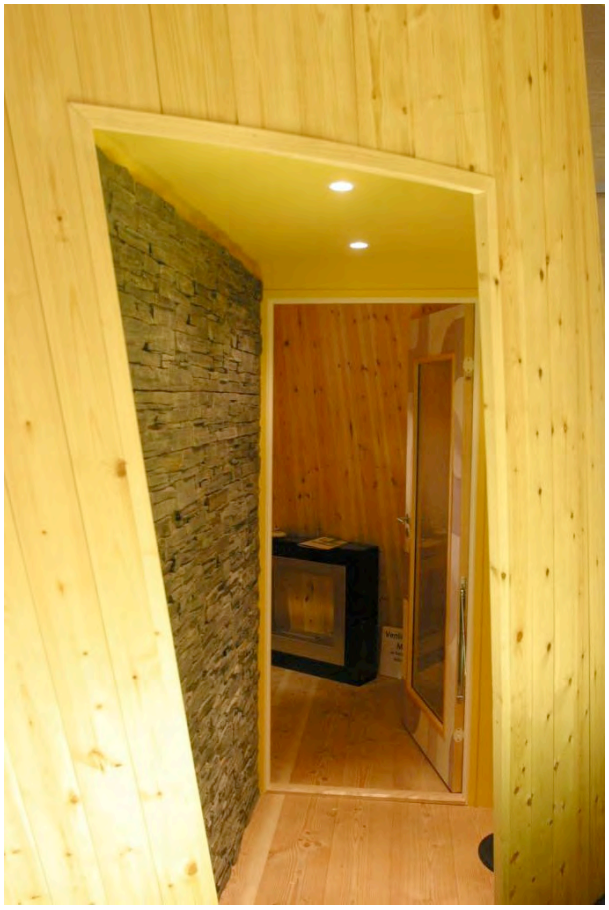
I particularly remember the day the kitchen was designed. Elsebeth and her boss from DESIGNA were visiting the construction site in Herning and walked around and were very uncomfortable about the schedule. Finally they said" It is today or it is too late". "Let's do it" I responded, and we drove to one of their most creative suppliers, Witt A/S, and we decided right there what to do. We innovated the entire kitchen, first of it's kind, in 3 hours. And it became great with the help from LINAK and other friends of the team.

In fact many things were a first ever. Nobody had ever tried putting rock shingles, square Rockwool batts, plaster, parallel zink plates or VELUX windows upon this double curved surface. But they all succeeded. The trick was that what works with the square wooden boards also works with other square things. But of course it only worked because the craftsmen were creative and found solutions. I have thought a lot of why we succeeded, and I believe that Eli has a key role, but also that the general mindset in the entire exhibition centre is "failure is no option, let's do it".

I was a little afraid that the modules with plaster could not be moved without cracking. We decided that we would wait with the last layer of finishing plaster until after it was moved for the second time into Hall M where the exhibition should be. But we did not find a single crack on either inner side or outer side. This experience gave me the idea to make a two step 3D printer, milling first the insulation and then covering it with fibre reinforced plaster. We could simply build the modules without the wood construction. The shape made anything incredible strong, just like an egg shell. Adding 4 tonnes of rock shingles on the facade was another ultimate test of strength. We doubled the weight and it did not break.

I have to admit that Flemming and I could not fully imagine the house. Even with the help of 3D renderings, models and photos of the full scale mock up many design decisions were made on site. For instance, the entrance to the wellness room. Initially the door was a kind of left over hole in the module necessary to enter the module and remove the roof support. But it happened to be beautiful. Unfortunately it was almost diagonal and hardly the shape you wanted for a door. We walked around at the site and found out that it was not at all diagonal. If we turned 90 degrees and walked into the room it was almost perfect. So we put up a partition wall with beautiful rocks to guide people the right way trough the doorway.

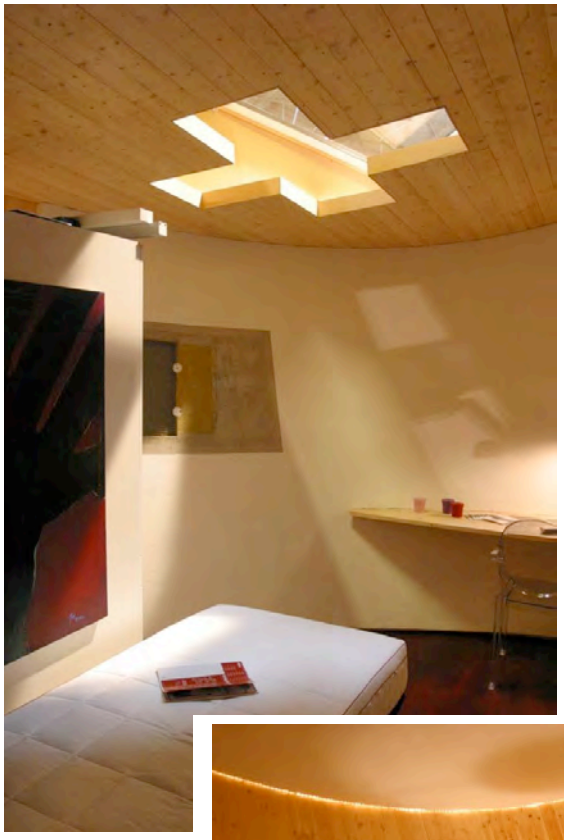
Even though we had tried it many times before it is always kind of a miracle that the house was actually finished in time. Everybody worked into late in the evening and there was hardly a fight about anything. The focus was on delivering a magnificent show. And together we did indeed deliver.



The entrance to the wellness room makes sense if you turn and enter perpendicular to the central axis.

This is the ultimate get together kitchen. Some shelves are in glass

Presentation were projected on switchable glass screen



The
Bedrooms

We were even ready ahead of time, leaving more time to the cleaning staff and decorators to finish the job.

I had written the speech for the grand opening ceremony over and over again and chose finally to focus on the fantastic team effort and the claim that a house like villAlive will change your life for the better. When the echo died away the message in the many media articles is still “villAlive change your life for the better”. And I firmly believe that is true. At least it changed my life. I was promoted to a key position in building R&D at Danish Technological Institute part time and started my own architectural office.

Jane Wickmann, my boss at the time, said that it made a great impression on her that being in the house was so much more exiting than seeing the photos I had sent her. Moving around in the house is an almost surreal experience. It is more 3D than any other building I have experienced and I have seen many of Gehry’s buildings. Usually moving through a cubical room is like zooming. What you see is the same, just closer. But moving around in villAlive is alive. Moving changes the perspective and particularly impressive is the central room that was designed in the Christmas holiday after construction has started. Good thing we changed the design.

The impression from a visit to the house was so strong that some people got a little dizzy. We investigated that phenomena, and found out that it was the sloping lines of the boards that confused their balance. If they were in the rooms with the plaster surface there was no problem. And in the central room the many different slopes also solved the problem.

After the exhibition we decided to move on and build villAlive outdoor. But that is the next story.

Some of you reading this might think that we were incredible lucky that everything didn’t end up in a catastrophe. But that is not the way we see it.

- We knew that we were experimenting
- We knew it was dangerous and were careful
- We moved small steps and tested performance
- We made small scale experiments before the big ones
- We asked for advice and listened

I will rather analyse why it not only went OK but was a success. Herning Messecenter was the best client and coach you could dream of. Always participating with support, smiles and high spirit.

- Having the client as contractor reduces the number of conflicts. The entire Messecenter organisation is furthermore used to fast action.
- We had great sponsors confidently letting us all do our outmost. The sky was the limit. As long as they could feel our enthusiasm, we had the green light. Nobody wanted to do something that was just barely OK. They wanted to exhibit the best they could do.
- The very concept of heading for the stars and glory made the building process resemble a sports game. All the talented craftsmen played their best to win. Nobody was hesitating or obstructing the progress.
- The everyday responsible Eli, Svend and Morten Post are the kind of people who find solutions rather than problems and they create a good spirit.

- As we knew that we were exploring unmapped territory, everybody was in their good right to ask questions, and my phone was open 24/7. And they did call, but usually not more than once a day.
- The high speed process, building the entire house in about 2 months, created a lot of momentum. To keep that momentum I promised to answer all requests of drawing, sketches and solutions within 24 hours. That spoiled quite a few nights but it was worth it.
- Working many craftsmen in the same room is usually asking for trouble. But in this case it was like a giant football team supporting each other. The carpenter did not have to wait for the electrician because he was working a few meters away.
- The common value was that a better solution should win over a less talented solution. The architect was not always right. It depended. The result was that the craftsmen found a lot of brilliant solutions and that increased the responsibility for the common result.
- I don't know for sure but I had the impression that the team was composed from a lot of right brain hemisphere people, hands-on, emotional people, who cared more about the good spirit, the process and the result than about rules, regulations, calculations etc.

Anyway, it was the greatest experience with building and innovation processes I had ever had.

Thank you everybody.

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