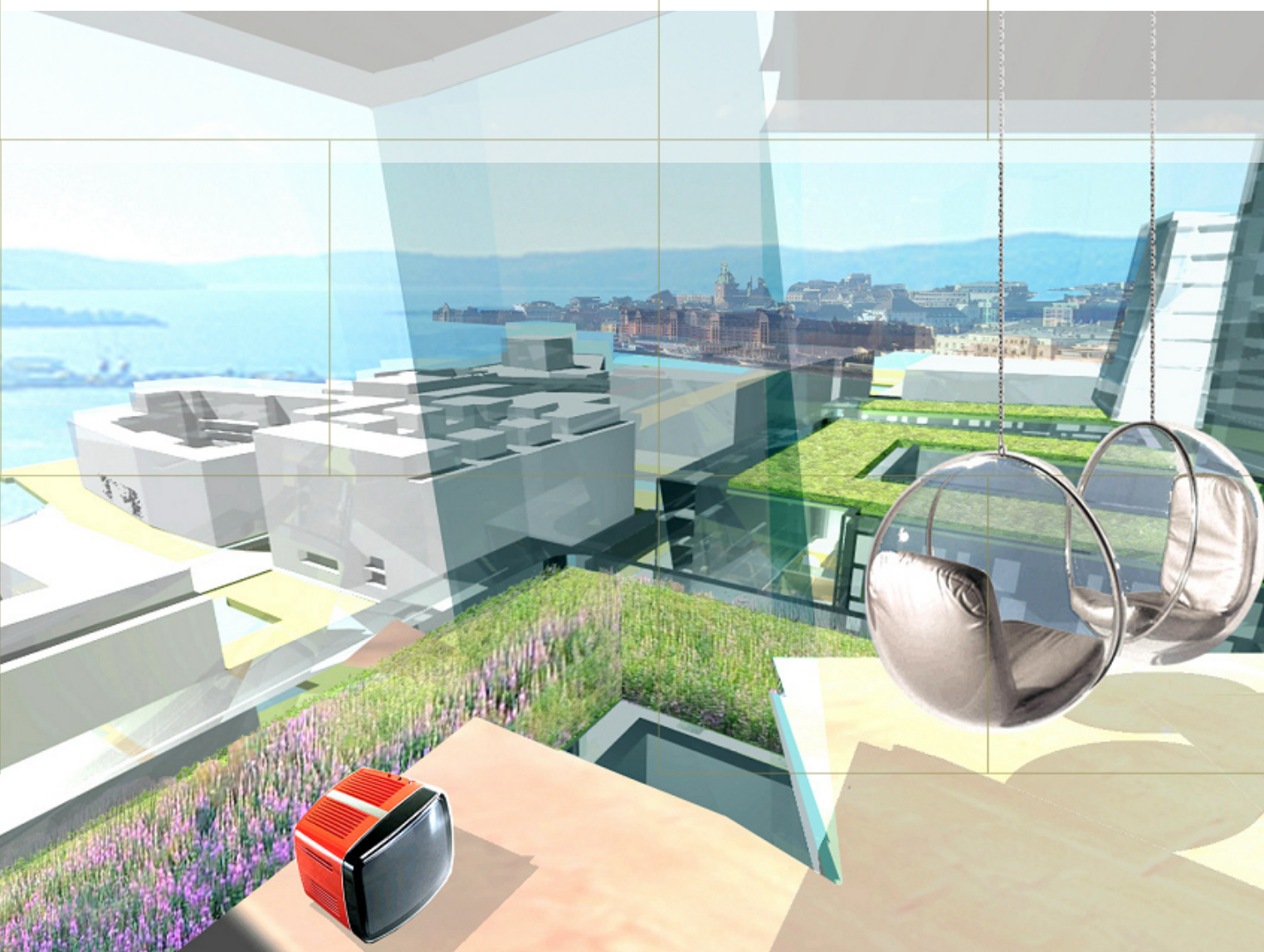


September 2005

Room for Humans



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Contents

1. Foreword	4
1.1 The two principal tasks of NICE.....	4
2. Task and working method	6
2.1 Members of the Think Tank:	6
2.2 Method	6
3. Summary	8
3.1 Great changes may be expected	8
3.2 InnovationsCenter.....	10
3.3 Target groups in the Nordic innovation system	12
4. Trends	14
4.1 Sustainable development	14
4.2 The new role of architects	14
4.3 The new contractor.....	15
4.4 Current R&D.....	15
5. Expected importance for the Nordic construction industry	18
6. Related websites	20
7. Appendices	22
7.1 The present situation in the Nordic area.....	22
Sweden.....	22
Finland.....	24
Iceland.....	26
Denmark	28
Norway	30
8. Attachments.....	32
8.1 Megatrends and driving forces	32
8.2 Important development factors in the world around us	33
Likely future events.....	33
ICT and technology in housing	33
Introduction	33
Technology in the housing of tomorrow.....	33
Technological trends in ICT ¹	33
Substitutes.....	34
Infrastructure	34
ICT services	35
Start of "virtual power plant" field test with fuel cell heating appliances.....	35
8.3 Research and energy use	35
Background	35
Energy use in buildings.....	35
8.4 Harmonisation of the construction market in the North/Europe	36
8.5 European focus areas for inputs in the field of construction	37
8.6 The production process	39
The construction worker of the future	41
Scenarios	41
8.7 ERABUILD (www.erabuild.net)	42

1. Foreword

The Nordic InnovationsCenter has come to the decision to focus on a holistic approach to the entire construction industry by establishing a Think Tank within "Innovative Building". The task of this Think Tank is to define and delineate, on the basis of its background as experts and interested parties, the specialist area which is recommended to the Nordic InnovationsCenter. The aim of the group's work is to produce a report with recommendations for new initiatives that promote innovative construction in the Nordic construction industry.

There are evident needs for new thinking in planning the buildings that shall house future dwellings and activities. The construction process, in contrast to all other industry, is still a craft and is in great need of effectivisation. A paradigm shift must be accomplished: Will there be a narrower optimisation process in construction development, or can an innovative market/industry flourish around the renewal process? Are new roles needed for the players, are we going to get relations of a more long term nature among the participants? Will there be new thinking on management and control of the whole supply chain and production process? Can new technology in construction provide greater societal (environmental) gains and a better utilisation of resources? Is there a need to develop systems for experience feedback? We have a positive view of recommendations within innovative construction where different materials (wood, steel, aluminium, concrete and glass, and also new textile materials) are promoted and where the focus is on new technologies (e.g. nanotechnology, microtechnology and sensor technology).

The Nordic InnovationsCenter wishes to see the setting of priorities and recommendations as to what provides the best synergies in achieving the goals of the campaign. Issues concerning harmonisation, restrictive practices, the common Nordic good and relevant target groups shall be involved in the task in order to strengthen the Nordic domestic market. The point of departure is to strengthen the industry in global competition.

1.1 The two principal tasks of NICE

The Nordic InnovationsCenter shall attend to two principal tasks in Nordic economic cooperation:

1. Stimulate increased innovation in the Nordic countries through greater cooperation among those active in innovative work in the countries
2. Work to make the Nordic area into one single market through removing barriers to trade and stimulating greater competition.

Stimulation of greater innovation in the Nordic area

The volume and quality of innovation shall be stimulated by making all important innovation resources available across the frontiers between the Nordic countries, and by promoting the development of an improved innovation policy in the Nordic area. This involves, inter alia:

- Improvement of innovation policy
- Cooperation among the national innovation systems
- Network and synergy projects
- Enhancement of the innovative character of activities

The Nordic area as a well functioning single market and as a region without frontiers

In order to get the Nordic countries to function as a single market, constant charting, and removal, of obstacles to market activities across the frontiers is necessary. This work primarily focuses on

- Removal of frontier obstacles; this includes harmonisation of rules and methods
- Improvement of competition conditions across the frontiers

It is particularly important that the activities of NICE in this area should be viewed as part of the Nordic countries' relations with the EU.

2. Task and working method

2.1 Members of the Think Tank:

Valdís Bjarnadóttir, architect in private practice FAÍ, FSSA
Ole Gustavsen, Snøhetta AS
Hans-Eric Johansson, MSc, consultant, Chairman of Think Tank "Bygg"
Ivar Moltke, Innovation Consultant, Teknologisk Institut
Elling Nygård, ICT Consultant
Ib Steen Olsen, National Agency for Enterprise and Construction
Per-Erik Petersson, SP Swedish Testing and Research Institute
Leena Sarvaranta, Group Manager, VTT Technical Research Centre of Finland

The task was to analyse, with reference to the personal experience of the members in the construction sector, how a Nordic innovative programme can invigorate the Nordic construction sector.

The members of the group have been appointed by Nordic InnovationsCenter. The group comprises three architects and three persons associated with national R&D. The group also contains three members with broad experience of the economy of the construction sector.

The composition of the group does not indicate a bias towards specific areas of interest, since the members have been selected on the basis of personal references. However, most of the members of the group have experience of housing construction, which has therefore been the area which most of the discussions concerned – this does not mean, however, that the housing sector has been defined as a primary target area.

NICe has not guided the working methods or the discussions. These emerged during the process. Three meetings, one of which lasted two days, have been held between March and June 2005. The creation of a functioning group and a working method, the making of decisions and the delivery of a result, have therefore been accommodated within this very compressed time schedule.

Recommendations and the articles in the report were written by the members between the meetings. Work has been based on a common Scandinavian language. Nordisk InnovationsCenter has taken an active part in editing the results but has not guided the conclusions or the contents of the report.

After the longer second meeting, the Think Tank reached a consensus in principle concerning a recommendation for the direction of the programme. The report and the recommendation were completed in this positive spirit. The group regarded the consensus of such essential importance that we have refrained from trying to limit the recommendations to narrower areas of focus, on which it would probably have been more difficult to reach complete agreement.

2.2 Method

The work was performed according to a conventional methodology: Analysis – synthesis – conclusion. In connection with the analytical stage the members provided their own reference material, most of which is referred to in the report.

Analysis of

- The market situation – needs in the Nordic countries (basis: housing construction)
- Industrial trends, benchmarking in relation to other industries
- Players, especially small enterprises and potential new players
- Analysis of previous Nordic R&D projects in the construction sector

- The surroundings – especially Europe

Synthesis:

- The Nordic area has a common cultural basis, is situated in the same climatic zone, and the countries have similar economic bases. Social structures are almost the same – but there are sufficiently large differences to prevent the Nordic countries regarding themselves, or functioning, as a self-evident single construction market.
- The conditions for the housing industry will be radically changed through increased international exchange of trade and services. Common European construction regulations and product standards will accelerate this development.
- We do not want to see R&D programmes which intend to solve today's problems in the construction sector. We want to reach much broader groups with these calls – far outside the traditional construction sector.

Conclusions:

- We want to see projects with a reasonable project period, and the ambitions of the projects must be commercially achievable within ca 5 years.
- We see two clear elements in the projects – software and hardware – preferably in combination. Analysis of needs: "to make the right things", and analysis of processes: "to make things properly".
- The Nordic countries – with their strong tradition of functional design – can make a substantial global contribution to a new industry that focuses on industrialised construction, based on future human needs of functions and experiences in and around our buildings.

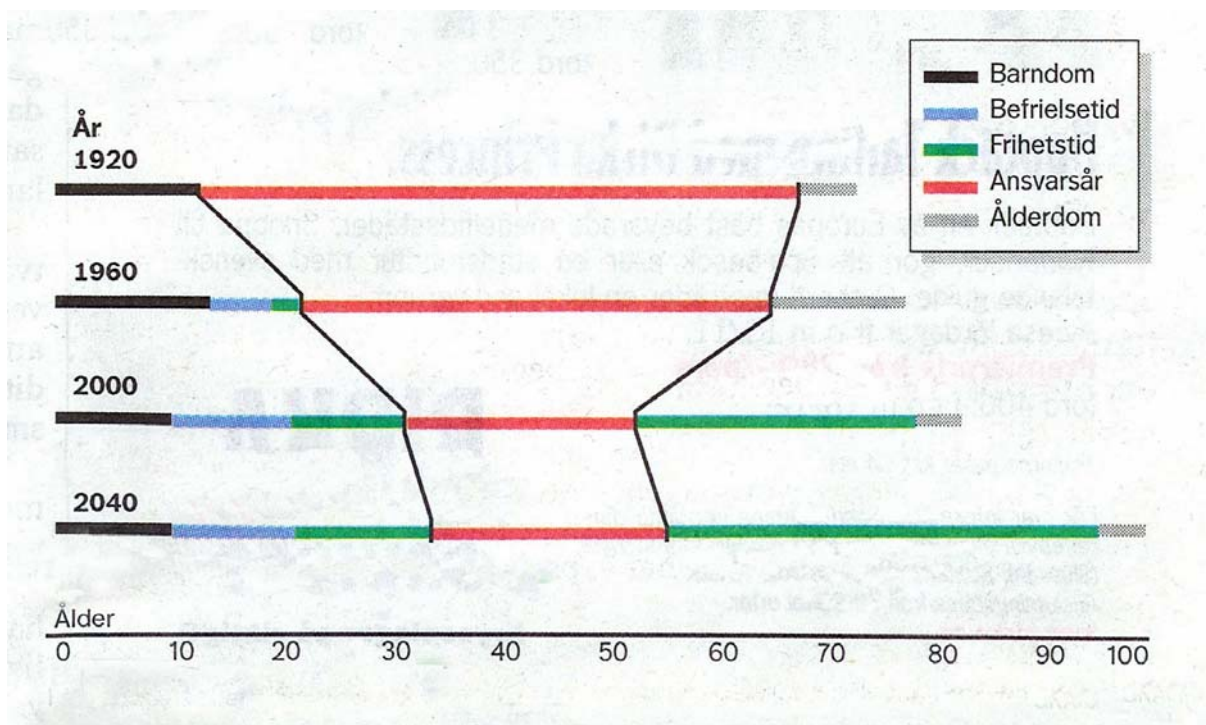
3. Summary

3.1 Great changes may be expected ...

There have been rapid developments in society over the past 100 years, and we here in the Nordic countries have been in the front line of these developments. Democratic developments, a high standard of living, gender equality, the role of women in the professions and environmental issues are examples of the areas, in which the Nordic countries have had, and are still having, a considerable impact internationally.

During this period, the Nordic countries have left the agricultural society, have gone through the industrial society and are now well inside a service-producing society. During the same period, our world view has broadened – from a local community to being part of a global network on which we all depend, are affected by and are members of.

During this period, our way of living and working has been radically changed – from the given division of roles in the nuclear family to a network varying over time, in which it is the individual rather than the family which is in focus. The figure below clearly illustrates how the life cycle nowadays contains an increasing number of phases and time cycles of increasing length, during which individuals can live their lives as they choose. (Source: Kairos Future, Stockholm).



Age

Childhood
Years of emancipation
Years of freedom
Years of responsibility
Old age

Our way of working has also changed, with a clear shift from the production of goods to the production of services. "Safe jobs" hardly exist any more – the rate of change in the economy is very fast and the changes do not benefit all. New technology is constantly being introduced into all activities, and those who do not upgrade their knowledge run the risk of being left behind.

In view of such radical changes in living conditions, it is surprising that there has been no corresponding radical change in the design and contents of the buildings in which we spend a large part of our lives. It is true that workplaces have been affected by the character of the activity, but they no longer have the same function of a place of production but rather that of a hub for the activity.

In view of the different lives that are now lived within their walls, our housing is surprisingly unchanged over time. With the exception of certain variations in architectural fashions and with a space standard which reflects the economic conditions at the time of production, our housing is in all essentials constructed according to the same functional codes as 50-75 years ago.

The organisation of building technology and the construction sector mirrors the product – static and traditional. In all essentials, the techniques and methods used today are the same as at the beginning of the 1960s. The organisation of the construction process is also unchanged since mediaeval times – it still conforms to the craft approach of bygone days.

In an era when all other industrial products are manufactured with an increasing degree of automation, the relative costs of construction products have therefore risen all the time. For a long time there has been a political ambition that no more than about 20% of the disposable income should be taken by housing costs – today, this figure is over 30% in all Nordic countries and it is higher still in the expanding regions. The housing subsidies that were earlier used to control the price/demand relation have now mostly disappeared, and the market cannot assume this responsibility.

Market economy now sets the price for our housing: "A dwelling costs what somebody can afford to pay for it". This gives the construction and housing industry a special competitive situation which does not compel the industry to make its processes more efficient or to deliver its products to all in the market. This is not a symmetrical market – everybody needs housing, so the consumer has no zero option.

But housing is not just a good in the market – it is also an essential condition for social development. A society where certain individuals have a great choice while others have none at all will ultimately face the social problem that certain individuals will have nowhere to live in the local service society. For these groups, the cost of housing is too high – there is often no chance to get a foot on the housing ladder.

The content of the dwelling and the perceptions in and around this, and its functions, are then the driving force for greater housing consumption. The existing housing stock does not provide the broad spectrum that is being demanded. There is great potential for new solutions which consumers can regard as worth the price.

The Nordic Think Tank group was surprisingly unanimous in the assessment set out above. Faced with the task to form a creative scenario – a Nordic programme for the development of the construction sector – the Think Tank group considers that only a paradigm shift will provide a solution: New products, new contents produced with new technology and new processes.

A paraphrasing of Corbusier – "Revolution – and architecture" reflects the reasoning within the group.

The options – to improve existing techniques or to form new designs/functions to satisfy the well established market (or those who are well established in the market) - represent what we have been doing over the past 25-30 years, and the group therefore considers that such a programme will rather contribute to preserving and retaining what other forces will nevertheless radically change.

Our judgment is: Establish and develop a new approach for the Nordic property and construction industry – while there are still opportunities to guide this. Go in advance of the rest of Europe in working for change that entails very profound consequences for both society and the individual. It is a process of change which will take time since it will face powerful resistance. The building and building materials industry, including their organisational network, will naturally be affected, but there will be a profound impact on the banking and property sectors also if new value judgments set new prices for the existing properties and housing. Yes, all who own their own dwelling will be affected if value judgments and demand decide to follow new paths

3.2 InnovationsCenter

The projects financed by the Nordic InnovationsCenter shall combine new human needs of functions and experiences in buildings with the technical development of the product. Both private and public needs are included in the recommendations given by the group. The ability of society and the individual, purely economically, to demand these new functions is also an essential component of this area – more cost effective processes (LCC) and products are high on the list of preferences.

The projects must become commercially viable rapidly, i.e. within 1-5 years. In its discussions, the group has concentrated on housing, but this is due more to the collected competence profile than on an explicit direction.

In the project proposals, "building blocks" are preferable to the "whole building". It is important that those taking part in the projects have great engagement. It is important that the results developed should be transparent, e.g. demonstrations must be available within reasonable time and preferably in several countries.

The target group should be broader than the traditional construction sector and its players. An industrial base with a clear customer focus may be just as good a starting point for the development process as a deeply rooted embedment in the construction industry.

All projects in the NICE programme "Innovative Building" shall support long term sustainable societal development. What this means is not clear either today or in the future, since our knowledge of sustainability increases all the time. New explanatory models in this area are definitely included in the programme.

Finally, the aim of the project should clearly agree with the overall goals of NICE.

The Nordic InnovationsCenter shall attend to two principal tasks in Nordic economic cooperation:

1. Stimulate greater innovation in the Nordic area through increased cooperation among those engaged in innovation in the countries.
2. Endeavour to make the Nordic area into one single market and a region without frontiers through removing frontier obstacles and stimulating greater competition.

The focus should be characterised by the following:

- Experiences
- Lifestyle
- Flexibility
- Health/wellbeing
- The public good – Access for all

Construction in the future will to a greater extent be adapted to the individual needs, lifestyles and life phases, quality of life and value judgments of people.

What is new about this initiative is that it is looking for new values for the consumers, rather than focusing on concepts, products, processes, etc. In the next stage, new products etc will be created for the consumers.

It can be expected that companies in the future will pay much greater attention than today to the needs of groups of customers.

In the following, there is a detailed description of the selected thematic areas. The brief descriptions are not intended to be full accounts. It is essential that the applicants should formulate their applications so that emphasis is placed on the aspects that describe how the project will influence the industry in the Nordic area.

Experiences

- Life among the buildings (improvement of blocks; manmade landscapes and townscapes)
- architecture and design
- events – opportunities – (stimulating experiences)
- individuality (services, lighting, acoustics, disturbances, materials, colours)
- enjoyment of Nature

Explanations:

Improvement of blocks: In a planned and coordinated manner, and in a few years, to improve a large proportion of the buildings and outdoor areas in a block of buildings (urban district/buildings)

Manmade landscape: Manmade lakes, canals, beaches, hills, vegetation, which enhance the value of the building land

Townscape: Design of the town as a landscape, especially the skyline as in Pudong, Shanghai

Event: Activity that involves/engages people

Lifestyle

- People's changes in life phases
- travelling; mobility
- expectation of leisure time and concentration on this
- comfort
- freedom from worry (guarantees and service agreements)
- need for service and access to a choice of services (ease of contact), and communication
- consumer co-design

Explanations:

Consumer co-design: Design process in which the consumers can alter the design of the product, e.g. by fitting it to the body, work, temperament, needs of the consumer.

Flexibility

- Multi functionality in use; use changes during the day, season, year and life's phases
- Design for all
- envisage the different needs which may arise in the daily life of a human
- multiple use of the dwelling; home, leisure time, work, child/childless
- life phases; change of the use of the dwelling
- opportunities for change – modularity as against harmonisation

Explanation:

Design for all: Design that makes it possible for the building to be used also by the physically disabled, the sick, or people with other types of disablement

Health / wellbeing

- Physical and mental comfort
- quality of life
- health
- environment
- security

Public good – access to all

- viability
- human sustainability
- affordable price
- interesting and promotes industrial development
- novelty value

Explanation:

The good must be available to - and attainable by - ordinary people. The recommendations do not deal with exclusive goods which only a few people can enjoy. The cost (in actual fact the price) is therefore a very important factor and in this context the industrial perspective may come into play.

3.3 Target groups in the Nordic innovation system

It is very important that this initiative reaches the players who are able to drive the work to bring about change. It is important to establish networking projects which can increase cooperation and the transfer of capability among the Nordic countries. The projects must also endeavour to break down cross-border obstacles and to achieve synergistic effects among the Nordic countries.

Those who have a direct influence to change conditions can be schematically assigned to the following groups of players:

- inhabitants
- municipalities
- the service sector
- the State
- consultants/architects/ building planners
- contractors
- producers
- estate agents
- financial institutions (mortgage societies, banks, funds)
- manufacturing industry

The projects within the initiative Innovative Construction must be embodied among a sufficiently large number of players in order to create a Nordic benefit. In order that the projects may be embodied at national and inter-Nordic level, the projects need participants who can assume responsibility for disseminating and implementing the results in the construction industry and other related industries. This does not mean that only large construction companies can apply for funds; the mix of participants must have the combined ability to reach out and modify the market. The players must come not only from the construction industry but may be IT/electronics firms, engineering industry, authorities and institutions that support innovation.

For a number of years, clusters, nodes and networks of various kinds have developed, and we are calling to those who have been at the forefront of the development to become involved for Nordic cooperation and national impact. The projects must have a pioneering character which can pave the way for others concerning contents and methodology and as the bearers of results. The projects must

create dynamics through developing their theme by acting towards a strong Nordic innovation system in the construction industry.

4. Trends

4.1 Sustainable development

There is not a single barrier that keeps environmentally sustainable business from taking off. A whole range of issues must be considered. There is very little research available on the business opportunities of sustainability, or the commercialisation of environmentally sustainable products. They come into conflict with the current industrial structures, organisations and institutions, and with the general behaviour of different related players. Formal rules may be changed quickly through decision making, but informal rules embodied, for instance, in customs and traditions are more deeply rooted. In this situation, special measures are needed to promote commercialisation. Sustainability alone is not a strong enough sales argument. It is natural for consumers to emphasise other qualities. In many cases, environmental friendliness and sustainability are not the foremost drivers of consumer behaviour. Consumers needs and preferences concentrate more on down to earth and everyday issues such as comfort, appearance, usability and safety. The role of local authorities as possible "niche managers", is therefore gradually receiving more consideration in many municipalities.

To achieve broader acceptance, a transition towards sustainability is needed in society. This transition cannot be managed in the traditional manner by control and supervision. But it can be managed in terms of influence and adjustment. This means that the pace and direction of transition can be influenced. In practice, this means creating the right climate for innovations and taking the right initiatives at the right moment. Transition management attempts to bring about the necessary structural change step by step. Structural change is needed to tackle the institutionalised structures which hinder wider acceptance and the development of environmentally sustainable business. Experiments with alternatives to the existing system have an important role in the transition process, as they provide the seeds for change.

4.2 The new role of architects

The yardstick for architecture has changed from m², kg, °C, lux and \$ to the yardstick of the brain: "a difference that makes a difference". Architecture has now become an information filter between the user and his surroundings, an interface between man and his habitat. It is not just a trick. It is a difference that makes a difference for you too. It makes a difference to your next building. To your life.

The aim of architecture is for man to prosper, develop and contribute. It is then necessary to make man the focus instead of the building, which is only a means to an end. In the physical entity of the building, information is to be considered as noise to be screened. But if we consider architecture as a filter/interface for information, then we can sort, distil and organise. Information has input and output, resonance, frequency, strength and many other functions. It comes down to choosing the information we want and maximising it. Architecture can be interactive, it can tell stories and it can function as an interface which creates contact between people.

Architecture is a filter/interface between people and natural resources. An extra skin to our clothing. Something that both receives solar energy and screens us from the worst depredations of the climate. Something that can provide comfort without wasting resources.

We have an affinity for water, flowers, fire, open views, sunsets and other natural essentials. We also need sunshine to create vitamins and to relieve depression in winter (SAD). And we have a need for safety and comfort. Here also, the interface/filter theory can be considered in terms of something physical with an informational condition.

Rather than become stranded in some historic backwater where our perception is conditioned by material discoveries made around 1000 years ago, architecture is able to respond to changes taking place in our knowledge society. It would seem that there are a number of evident development trends for successful enterprises, e.g. that business life has become more like a competition where the winner takes all, and that it is the customers who determine who is the winner.

A new concept has therefore arisen, "user centred innovation" which focuses on whether the product/service can create more value for the consumer by enhancing sensory or meditative experiences, reminding him of something, being handy, teaching something new, enhancing freedom and mobility, saving time, money and work, being a means of making money, making contact with new and old friends, creating identity and prestige, providing new insights and understanding, enhancing security, safety and health, a longer service life, causing less worry and trouble. In other words, it is something that the consumer wants so much that he is prepared to pay more for it.

The challenge is that in most cases the consumers themselves cannot decode their needs, and that they buy something different from what the market surveys say. The working methods in user centred innovation therefore range from conventional market surveys, focus groups in consumer networks, consumer configuration in e-commerce, beta tests, design tools which make it possible for consumers to design "mass customisation" products, to analyses of consumers' subconscious needs through metaphors, in-depth interviews, empathy with the consumer situation, and living with the consumers. The optimal objective of market and consumer driven innovation is to make the consumers so enthusiastic that they recommend the products to others.

What is most obvious is to improve existing products/services, but the best results are often achieved when the unsatisfied needs of "non-customers" are identified or when products which customers are not pleased about are removed/substituted. Innovation has particularly good opportunities when changes occur in the consumers' lifestyles, demography or subculture, and/or social conditions, subsidies, legislation, competition conditions, and/or new technologies are introduced.

4.3 The new contractor

The traditional role of the contractor as a producer is becoming increasingly peripheral. This is the reason that all the major contractors are changing into developers. It is in the role of the developer that the great influence and value creation are to be found. It is developers who are in contact with customers and thus have the key to user centred innovation with respect to construction.

For a new generation of contractors it should not be very difficult to prevent obvious mistakes (or failures) and in this way to strengthen their position in the market with better quality and lower prices.

The developer must not only know what the trends are, but must also be ahead of them. But there are many other groups in society which pave the way and can influence what it is that deserves great attention. It is to be hoped that society will in the future give greater importance to lower consumption as well as better quality and better contact between people and with nature. In this respect, the role of construction as the catalyst for positive human development is extremely important.

4.4 Current R&D

The Danish Technological Institute has therefore developed a model which contains both the technical development in producer activity (left column) and the views of the consumers regarding this innovation (right column).

Life Cycle Cost/Benefit (LCC/B)

Cost (LCC) (from the commercial standpoint)	Benefit (LCB) (from the standpoint of the consumer)
Production phase	Incorporated in the product
Management, strategy	Brand value, i.e. the confidence of the consumer in the sense of responsibility of the producer for the value and reputation of the product
Innovation (incl. societal/generic development of the market, technology, expertise and legislation)	Unique value, added value, exactly the value needed, more value for money, or a completely new value
Design (incl. lifestyle, trends, fashion)	Consumer perception (see the first 7 points in the consumer phase)
Mass customisation	Fit, i.e. that the product is fit for the body, life, work etc of the consumer
Productivity, outsourcing, resource consumption	Potentially lower price
Salary and working conditions, legislation	Ethics, no to child labour
Marketing	Choice, comparability and prestige
Distribution (incl. just-in-time, e-commerce)	Easy access to the product
Sales	Customer perception
Finance, leasing, payment by instalments, interest only loans	Payment conditions
Operation phase	Consumption phase
Network with consumer, consumer guidance hotline	Income
	Saving of money
	Saving of time
	Safety, security, health
	Perception, beauty, sensuality, comfort, flow
	Social value, identity, connecting people, prestige
	Freedom, mobility
Energy	Movement, lighting, AV, AC
Infrastructure	Overall functionality
Guarantee (economic and functional), maintenance	Trouble free reliability
Functional upgrading, modularity	Flexibility, compatibility
Environmental code compliance	Environmental quality
Hobby	Collector's item/exclusivity
Social value, business upswing, second-hand market	Sales price
Recycling phase	Disposal
Sorting of components	Deposit
Return systems	Scrap/waste charge
Reclamation plant	Environmental ethics
Waste	
Bottom line (producer's value/profit)	Bottom line (consumer's value/profit)

On applying this scheme to the construction industry, the working group discovered the following:

People, society, consumers are the central components for future construction, and when values are to be determined, it is the price and the future profit that are counted. In order that humans may be placed at the centre of construction, continual monitoring and development is required of issues that concern:

- productivity
- production
- energy/resources
- maintenance
- adaptation to new techniques
- automation/control

Gains from the human standpoint are

- security/freedom from worry
- flexibility
- lifestyle
- quality
- design
- freedom
- sustainability
- mobility
- good traffic infrastructure
- improvement of quality/landscaping/improvement of block/town

The players who have direct influence to change conditions are

- inhabitants
- municipality
- State
- consultants/architects/building planners
- contractors
- producers
- managers
- developers
- estate agents
- financial institutions (mortgage institutions, banks, funds)
- universities/institutes

5. Expected importance for the Nordic construction industry

The Nordic geographical region has such large fluctuations in weather and temperatures that these have at all times been the focus in construction, and a lot of resources have been used in this respect. A large industry has therefore developed for both the production of building components and for the construction of buildings. It is pointed out in some reports that more than one third of the private industry in the Nordic countries is related to construction in a broad sense.

In 2004 the Nordic Council of Ministers issued a report *Comparison of building permit procedures in the Nordic countries*. The report places emphasis on the areas where there are essential differences between the countries, and the areas where changes in legislation should be made – for instance, client responsibility/authorities and "auxiliary roles", qualification requirements and approval procedures, conditions, etc. There are great differences.

Housing is mostly outside the scope of EU agreements and is essentially governed by national regulations. An increasing number of directives are however being issued which have a great influence on construction and housing, for instance concerning energy and building products. When the service directive is finally issued, it will have a great impact on the construction industry. The EU has also defined a technology platform for construction (European Construction Technology Platform, ECTP, see Section 2.f in the Appendix). According to ECTP, the most important mechanisms for innovation in the construction industry are

- product suppliers
- technology transfer/inspiration from parallel industrial sectors
- individual creativity
- initiatives from firms and consumers

In the Nordic countries, the construction industry is increasingly made up of large firms that have become internationalised. We should like to influence and change the construction industry, but strong signals are needed. New requirements are being introduced for the industry, and a cost reduction is immediately needed. Material costs are often referred to as a strong cost-driving factor but this is far from being the whole truth, it is rather the process related costs that raise prices. The representatives of the industry do not like to talk about this, since the industry makes money by working in this way; views on this must come from independent observers who have an insight into the structure of the industry.

However, the construction sector is wide in scope, and many are interested in future developments – new players may very well emerge. It is not difficult to see the potential in e.g. energy issues, and in a common Nordic approach to the valuation of our buildings in future, e.g. through the LCC approach. Sustainability and design are other themes which should attract consumers in the future.

There is a need for a consumer oriented approach which puts people in the centre, and where the approach is not what people shall have, but consideration of the personal needs. In Norway, flats are built without kitchens in order to maximise space for those who want to have it so. We should integrate work and housing. On condition that we do not install components that cannot be moved, it should be possible to alter dwellings for people who, for instance, do not want a kitchen. The building must be put at the centre of human development. There are firms that offer customers the opportunity to choose what they want their house to look like, so that costs may be adjusted. It is not unusual for buildings to be constructed so that they can be adapted for different needs.

Young people perhaps want to be mobile and do not want to tie themselves to the same place for life. Will young people have a mobile approach to their existence? Some buildings can be mobile and be dismantled, moved and recycled. Modularisation and component manufacture are needed. It is important to put the focus on human needs and the way they can be supported by new technology

and services. Cars consist of modules, but in construction the same does not apply. We need "mechanics" who assemble components. Where are the new and exciting firms that can build modules? Student flats must be inexpensive, and they are suitable for cheap modular construction. Quite simply, they must be cheap. Delivery times are observed, prices are lower and quality is improved. The construction sector should be able to support this, and also the less materialistic attitude that may develop since the time for supplier liability is reduced. It is essential that this initiative is not too "technical" but considers several values. Perhaps a global system is needed to modify these mobile types of buildings? We must have a view of housing that is completely different from that today, since our lifestyles change over time.

6. Related websites

Companies/groups:

www.alvsbyhus.se
www.finndomo.se
www.lindbacksbygg.se
www.martinsonstra.se
www.moelven.se
www.ncc.se
www.openhouse.se
www.peab.se
www.skanska.se
www.sodra.se
www.motiva.fi
www.vfs.is
www.byggmodul.moelven.com/
www.systemhus.no

Authorities, units, national and trans-national forums:

www.byggkostnadsforum.se/swwwing/app/cm/Browse.jsp?PAGE=1111
www.miljo.fi
www.sitra.fi
www.tekes.fi
www.tekes.fi/eng/publications/policies2005.pdf
www.rannis.is
www.iti.is
www.fmr.is
www.samband.is
www.erabuild.net
www.erabuild.net/coop_call.html#coop_clustering.html
www.ectp.org
www.e-core.org
www.ebst.dk

Research institutes and universities:

www.cbi.se
www.competitivebuilding.org
www.chl.chalmers.se
www.indbygg.hbg.lth.se
www.kth.se
www.lth.se
www.luth.se
www.stalbyggnadsinstitutet.se
www.tratek.se
www.aka.fi
www.minedu.fi/minedu/education/universities.html
www.minedu.fi/minedu/education/polytechnic.html
www.bifrost.is
www.borg.hi.is
www.hi.is
www.vtt.fi
www.vtt.fi/virtual/constrinnet
www.rabygg.is
www.hvanneyri.is

www.ibudalanasjodur.is
www.lhi.is
www.ru.is
www.byggforsk.no
www.prognosesenteret.no
www.sintef.no
www.by-og-byg.dk
www.byg.dtu.dk
www.teknologisk.dk

Trade organisations / associations / interest organisations / funds:

www.atl.fi
www.finpro.fi
www.te-keskus.fi
www.kiinteistoliitto.fi
www.kiinteistoliitto.fi/asunto2010
www.lvi-vvs.fi
www.rakennusteollisuus.fi
www.rakli.fi
www.rts.fi
www.ai.is
www.skolry.fi
www.woodfocus.fi
www.fit.rl.is
www.lafi.is
www.si.is
www.tfi.is
www.trnet.is
www.vfi.is
www.teknig.dk
www.obos.no
www.obos.no/index.asp?title=Datterselskaper&aid=1906
www.bi.di.dk
www.bips.dk
www.bygherreforeningen.dk
www.byggecentrum.dk
www.bygnet.dk
www.byggeevaluering.dk
www.byg-erfa.dk
www.dal-aa.dk
www.danskbyggeri.dk
www.dcft.dk
www.dfm-net.dk
www.frinet.dk
www.ida.dk
www.par.dk
www.realdania.dk

7. Appendices

7.1 The present situation in the Nordic area

The housing sector and the construction industry are broad in scope, and it is still more national than European in its orientation. This appendix describes the overall conditions governing the industry and the trends in the national dimension. In order to present a reasonable picture and to compare the countries, an overview is given below of

- the housing stock
- the scope of new production
- national regulatory systems (special conditions)
- national housing policy
- trends in industry and policy

Sweden

Housing stock:

The number of dwellings is ca 4,500,000, 54% blocks of flats, 46% single family houses. 40% of the population lives in blocks of flats, 60% is single family houses. The proportion of non-rental dwellings (incl. jointly owned tenant-owner dwellings) is just over 60%.

This proportion is on the increase as new dwellings are constructed and the tenants jointly buy the building from the owner and register it as a building held on a tenant-ownership basis.

New production

Annual new production at present is ca 25,000 dwellings, half of them in blocks of flats. Only about 30% are rented (of which almost half are student flats), the remainder are single family houses or buildings held on a tenant-ownership basis (owned by the consumer). Four large construction firms develop, construct and sell 40% of all housing.

Regulatory system:

For housing in private ownership, 30% of capital costs are tax deductible. There is a rent control system that maximises the rent for all dwellings in blocks of flats. The system is based on comparing the rent with that for dwellings of the same standard in buildings owned by non-profit housing enterprises. These rents must not be exceeded in newly produced blocks of flats. There are specially targeted housing allowances for those with the lowest incomes (ca 10-15% of households).

Housing policy (ca 10 years' retrospective)

Up to 1993 there was a State subsidy system with large interest subsidies. This system was applied to more than 90% of housing production. In return, there was price control of production costs. The system was very expensive for the State finances. The system was discontinued in 1993 and housing production dropped from 59,000 dwellings to 12,000 in two years. It was production for rent that was hit hardest, since the rent control system with the maximum rent based on comparable units was not abolished.

Housing production has now increased to ca 25,000 dwellings annually, but dwellings for rent still account for only a small proportion. The State has therefore been obliged to re-introduce certain direct subsidies for small rented dwellings (subsidies cover VAT), with the requirement that the rent (not the production cost) must be below a certain level.

No new political moves are planned; the housing sector is no longer an area where political points can be earned. Sweden has therefore had no Ministry of Housing since the middle of the 1990s; these issues are handled by the Ministry of Finance with the assistance of a number of State agencies, chiefly the Swedish Board of Housing, Building and Planning.

In Sweden, people are not allowed to own their flat – on the other hand, joint ownership with individual right of disposal is permitted (tenant-ownership). The difference is no longer so critical that a political party would want to make a stand about it. The only new element being considered is that "three-dimensional" land registration will be permitted in future. This means that a tenant-owner association can own its property above a shopping centre, which was not possible before.

Trends

Housing construction in recent years has mainly increased in the growth regions Stockholm/ Mälardalen and on the west coast incl. Gothenburg and Malmö. What are primarily built are exclusive dwellings in good positions which are sold on an ownership basis (single-family housing) and tenant-ownership (blocks of flats). The lack of small dwellings for rent has increased in the meantime, and this necessitates special measures to encourage such production.

From having been an inflationary economy with 7-8% annual inflation, Sweden nowadays has a cost development that is the same as in the rest of Europe, i.e. 2-3%. Interest rates have been adjusted in view of this; variable interest on housing is now below 3% and the interest on 5-year term loans is below 5%. These low interest rates, in combination with liberal loans for housing purchase (officially up to 90%, but in practice higher) have been driving up the price of new production. The quality of housing has been raised overall, but it is primarily the increased demand that has raised the prices for construction on land in a good position. Many expensive development schemes have therefore started, some in previous harbour areas.

Construction of single family housing has also increased in recent years, but not to the same extent. The lack of building land in the growth areas imposes a limit.

There is now a demand for housing in most medium sized towns in Sweden, and it is mostly student flats which are in short supply. There is therefore increased housing construction in all major towns, but the high production costs are a serious problem. The traditional production system cannot produce student flats within the stipulated cost requirement – most student flats are at present prefabricated (often of timber) and assembled on the site.

Foreign construction firms have begun to enter the Swedish construction market, but they are strongly resisted by the building workers' union. The employers – the Swedish construction firms – are watching developments and are not at all so negative. For them, a future market with foreign construction firms acting as subcontractors can be a good solution. By virtue of the fact that they already own future building land – and have the right local contacts – they can nevertheless dominate, and set the price for, the construction market.

Industrialised construction is an interesting field of development, and both the Swedish Board of Housing, Building and Planning and the construction industry consider that it has great potential for making housing construction more efficient. The universities have also shown an interest. Lund Institute of Technology now has a two-year Master programme in industrialised construction. A network between the industry and the universities of Lund and Luleå is being set up to develop an R&D programme for industrialised construction.

In Sweden there are a number of systems which try, with more or less success, to reduce costs by using industrialised methods of construction. The large leading construction firms have also realised that this development has come to stay, and they have started internal development projects. For the past 7-8 years, Skanska has been cooperating with IKEA in Bo Klok – standardised two storey buildings with six dwellings which are constructed using prefabricated modular units.

Finland

Housing stock:

The number of dwellings is ca 2,600,000, of which 60% are multifamily houses (15% terrace houses and 45% multi-storey buildings) and 40% (owner occupied) single family houses. The proportion of dwellings in private ownership (including those jointly owned) has been stable, just over 60%.

New production

Annual new production at present is over 30,000 dwellings, 55% of them in multifamily houses. The importance of the subsidised interest loan (Arava loan) has radically decreased in the past 10 years, and now it applies to only 20% of all housing. The four largest construction firms develop, construct and sell 35% of all housing.

Traditionally, multi-storey buildings account for a high proportion of both the housing stock and new production in Finland. Construction of terrace houses and privately owned houses is however a growing trend. Even the large construction firms have become interested in building estates of single family houses.

Through the nationwide project "dense and low-rise development", housing environments where people live in single family houses closely grouped together are being created. A programme with the aim of making it easier for the elderly to remain in their own homes is also being developed.

Regulatory system

There are ca 790,000 rented dwellings in Finland (2001). Through subsidised interest loans (Arava loans), the State has helped finance half of these. The other half of the rented housing is financed at commercial interest rates. It is primarily municipalities and non-profit associations which construct and own the Arava housing and the dwellings financed through these loans.

The tenants in both the Arava housing and in housing constructed with such long term loans are selected on social grounds. The rent in the Arava housing is determined on the basis of the cost price principle. This means that the rent must cover both the capital costs of construction and the costs of maintaining the buildings.

The rent control system on the free market ended in 1995. The rent for rented housing financed at commercial rates of interest is nowadays determined mainly by an agreement between the parties concerned and on the state of the rental market. Apart from private persons, rented housing financed at commercial rates of interest is also owned by e.g. insurance companies and associations.

Housing policy

The State puts emphasis on innovative regional development in general and on the use of timber in construction in a new way and to a greater extent than before. The present government has also included a quality strategy in the government programme.

The Ministry of Environment is responsible for the issues concerning the environment and housing that are brought up in cabinet and the Riksdag. The key points in the goals of the Ministry are

- to enhance the quality of housing, communities and the built environment,
- to safeguard the diversity of Nature
- to create an ecologically effective society
- to prevent environmental pollution
- to prevent harmful atmospheric changes.

The Ministry is in charge of strategic planning and work concerning management, and draws up the budget for the field of management. The sphere of administration of the Ministry comprises 13

regional environmental institutes, three environmental permit agencies, the Finnish Environment Institute and the State Housing Fund. In addition, the Ministry controls and finances the Board of Forestry and the Forest Research Institute in issues concerning nature conservancy. The Ministry further finances research and development projects connected with management.

The aim of housing policy is to secure a housing market in both social and regional balance, to put an end to homelessness and to improve housing. The goals for housing policy also comprise the production of enough housing at reasonable prices. All this is laid down in the government programme.

At the end of the 1980s the loan markets were deregulated in Finland, which markedly facilitated borrowing by private households. In turn, this gave rise to a construction boom in privately financed housing. The interest in social housing construction is still in decline owing to the low interest level (which is lower than the interest on the Arava loan).

In the present situation, housing policy in Finland is facing two serious challenges: shortage of housing in the growth centres and empty housing in thinly populated areas. The population is increasingly concentrated in the growth centres (the metropolitan region of Helsinki, Tammerfors, Åbo, Jyväskylä, and Uleåborg). Especially in Helsinki, supply and demand are out of balance. In central areas tall buildings are constructed, but people want single family houses. Construction of single family houses is on the increase in areas at a distance of a few tens of km from the city centres, which disrupts social structure and increases traffic – completely in contrast to the goals of sustainable development.

Trends

The following shared visions for the real estate and construction industries in Finland have been identified (Vision 2010):

- Functionality and premises of superior quality
- Functional and physical infrastructure markets as a success factor
- Significant added value for customer in cooperation with the ICT cluster
- International leadership in environmental expertise
- Occupant oriented housing markets

Three common challenges have been identified in the real estate and construction industry:

- Customership
- Partnership
- Life cycle expertise

Proposal for the Better Housing 2010 Programme

In 2003, the real estate and construction industry, together with Tekes, the National Technology Agency in Finland and the Ministry of Environment, launched a preparation phase ambitiously aimed at creating a programme to promote better housing in Finland. These projects have been presented at seminars and the relevant information has been published in brochures. A major network of similar development projects is to be engaged during the programme.

The ambitious objectives of Better Housing 2010 require that internationally competitive business concepts concerning housing and house production will be recognised, actively developed and taken into use.

The structure of Better Housing 2010 is relatively extensive and there are no previous research or development programmes with the same concept. The programme could be described as an umbrella project to greatly improve development activities in the field of housing. Suggested activities for the Better Housing 2010 programme include some relatively diverse yet connected chapters:

- Residents' needs and product requirements
- Products, processes and business concepts
- Urban and regional planning
- Legislation and official administration of housing
- Housing finance and investment market

The main aim is to create a new and strong multidisciplinary sector of housing research along with the necessary research units and a Centre of Excellence in research. Housing topics are well represented in the fields of high technology. The results of research are in many ways connected with housing, real estate or construction. The end-use applications of information and communication technologies (ICT), ADP networks and even nanotechnology could be directed towards housing.

Iceland

Housing stock

The number of dwellings in Iceland is ca 112,000, of which ca 70,000 (62%) are in and around Reykjavik. 42% of the population live in single family houses, 12% in two-family houses (terrace houses are blocks of flats). 80% of housing is privately owned.

Iceland has a population of fewer than 300,000, 60% of whom live in and around Reykjavik and 70% at less than one hour's drive from Reykjavik.

New production

New production is ca 800 dwellings annually, most of which are in and around Reykjavik and are sold on the private market. Five large construction firms now build and sell 25% of all housing in Iceland. 75% is constructed by small firms or private persons.

Up to the autumn of 2004 there was a central loan system where it was possible to borrow a certain sum regardless of how large or expensive the dwelling was. Most people therefore initially bought a relatively small dwelling and then changed to larger and larger ones at intervals of a few years. In the autumn of 2004 almost all banks offered loans of up to 100% which caused a colossal change. Young people are now buying relatively large and expensive dwellings as their first home, with loans of up to 40 years. Large demand in recent months has caused prices to rise.

Regulatory system

Most dwellings are privately owned. The rental market is not large, and it is quite new that private dwellings are specially built for rent. It is not long ago that the municipalities allocated building land to private person on payment of oncosts for supply services (water, sewerage, electricity, roads, streets and paths). DIY was most pronounced up to about 10 years ago when the construction firms took over the market. These build and sell housing in such a way that the purchasers can themselves choose the fittings, e.g. flooring, internal doors and cupboards, and technical equipment in kitchen and bathroom, and maybe also the number of partitions and thus rooms.

A special Housing Finance Fund gives loans to private persons for the construction or purchase of their own house or flat, and for renovation. Loans are also given to construction firms. Loans can be for up to 70% of costs for the first flat, otherwise 65%. Loans to persons or families with the lowest incomes are up to 90%, and the same applies to firms which build and sell completed dwellings to private persons.

The fund also loans to municipalities for the construction of social housing. Those who rent dwellings receive rent subsidies if their income is below a minimum level. All loans are indexed with a rent guarantee, and the term is up to 40 years.

From the autumn of 2004, all banks give indexed private loans of up to 100%, and this has had a big effect in the past few months in raising prices and increasing demand for larger flats and single family houses. The Icelandic housing market is very unstable and has radically changed over the past year. The new construction index has doubled.

Housing policy

Iceland has no Ministry of Housing. The aim of Icelandic housing policy is to enable most people to own their own dwelling. Owing to the large movement of people from the countryside to the capital and its neighbouring municipalities in the past few years, housing in many places in the country has lost its value. Municipalities rent out social housing (the number in Reykjavik is ca 1500). The government decision to construct a large hydroelectric plant in the east of Iceland two-three years ago has had a large effect on the construction sector.

Trends

Almost no surveys have been made into the construction industry or market needs, apart from some surveys construction firms have made among their customers concerning the way they want to have their flats equipped. As a result of these surveys, wishes concerning innovations are not made by the customers, and it is not until the innovations appear on the market that there is demand for them. Fashion plays a much greater role than the customer's own needs in fitting out kitchen and bathroom.

The way the new loan policy of the banks affects the construction sector is that larger dwellings and single family houses are in demand and rise in value in contrast to smaller dwellings which in past years were in greatest demand. Industrial buildings and e.g. large sports halls have in recent years almost exclusively been imported as prefabricated steel system buildings. The location of the building now has a much larger influence on the price than a few years ago, and quality also plays a much greater part. Even though a higher standard in housing construction should therefore be expected, no major changes have taken place in blocks of flats, with the exception that large and expensive flats in blocks of flats are now offered to those who no longer want to bother with gardening and the renovation of their own single family house, but demand that the block of flats should have the same quality as the single family house. Buildings, which have traditionally been insulated on the inside of the concrete wall and suffered from cold bridges as a result, are now insulated on the outside which enhances quality and the chances to select materials, and thus gives rise to more stimulating architecture.

During the past decades there has been a lot of construction. Because of the frequent changes in climate, extremely strong winds, a lot of snow, earthquakes etc, the construction sector must produce sound technical solutions. Since temperatures in summer are not high, great importance is given to the actual buildings and fittings and techniques must satisfy stringent quality requirements. Because of relatively cheap energy and the availability of hot water for heating the buildings, energy conservation is not accorded great importance.

Concrete is the local construction material in greatest use, a lot of investigations and improvements have taken place, and new methods of application have been developed, such as self compacting concrete (but not yet transparent concrete). At the beginning of the twentieth century, corrugated iron was the characteristic material; timber and glass must be imported, and have been used a lot in recent years. Combined use of these materials has been a trend in recent years.

As far as prefabricated units are concerned, instead of standard units the manufacturers offer specially produced units in the shape, size and material according to the wishes of architects and customers. The price is about the same as that of in situ construction, but the units can be produced in the winter and the construction period in summer has therefore been shortened, which reduces construction overheads.

Denmark

New production

Owing to a boom in Denmark, construction activity in Denmark has been high since the beginning of 2005. It is private housing construction and renovation which, because of new forms of loan, have been driving this development. General construction and commercial construction are stagnating, although the latter has made progress. The large construction projects such as bridges and the metro have been completed, but there will be other construction projects.

In 2004, total investment in building and civil engineering construction was ca 150 billion Danish kroner. The breakdown of investments is: new building ca 35%, renovation including repair and maintenance 40%, and civil engineering construction 25%.

The total number of dwellings built is 27,000, of which 21,000 are private and 6,000 public/subsidised. Building starts in housing totalled ca 3 billion square metres of floor space - business construction ca 4 billion, and institutional building, including buildings for cultural purposes, ca 0.4 billion.

There are ca 25,000 firms with ca 180,000 employees.

In the autumn the Government will propose a framework agreement, cf. the new EU directives, for publicly owned family housing and housing for the elderly. The plan is to form, by competitive tendering, a number of consortia which offer building concepts/systems that are 20% cheaper than normal prices. The aim is both dense and low-rise housing and multi-storey housing.

The scheme was published by the EU on 11 May. More than 400 housing organisations have responded. It is expected that total construction over 4 years may amount to 3000-4000 dwellings, distributed over the nominated consortia.

Regulatory system

As mentioned above, the building regulations are being tightened up in order to reduce energy use. This also applies to building renovation.

The two existing regulations, for single family houses and other buildings, will in the next two years be revised with a view to simplification and the issue of a combined regulation in 2007.

A report by ATV (Danish Academy of Technical Sciences) charts the consequences of climate changes.

Housing policy

The development trends of the greatest interest in Danish construction are associated with Danish government construction policy.

A number of the official initiatives originate from a Task Force report of December 2000. In general, it is emphasised that the framework conditions for construction should be changed in such a way that the development proposals of the firms are encouraged. The overall aim is to give the construction sector a more demand/consumer oriented approach.

Direct public support for development work by firms is very limited and is given only in some priority areas.

With reference to a number of reports, the Government has adopted a policy for construction clients, according to which the State clients will impose requirements for building firms in three principal fields. These concern the collection and use of (selected) index numbers and a systematic evaluation of whether OPP (public-private partnerships) or partnering is appropriate in future construction.

This construction client policy came into force on 1 January 2004 for State construction, and is expected to come into force for general construction during the autumn of 2005, with the exception of OPP. The next stage will be to incorporate this policy in municipal construction. There are however already a number of municipalities which have started this in the above areas.

These construction clients (public construction) are judged to account for up to 20% of total construction. It is therefore expected that State client policy will have an effect on the remainder of the sector – and will in this way promote efficiency.

Trends

The State clients will proceed in the field of digitalisation. Requirements are being drawn up and will come into force on 1 January 2007. These requirements concern the following areas: use of 3D models, information management using project networks, digital tendering and digital supply.

A digital policy document is being drawn up, consisting of standards and methods, so that all parties in a construction project should be able to speak the same (digital) language. A new common classification system is thus being developed. Finally, a document entitled "Best practice in construction" will be drawn up which will set out the advantages and give good examples. The requirements will be tested in experimental projects in both new construction and renovation schemes.

In view of the criticism of the results of building research, there has been a discussion on opening State support for building research to greater competition by innovation consortia, comprising firms, research institutions and clients, which will also contribute to costs. There is no final clarification.

State support for the Danish Building Research Institute (SBI) has been reduced. In a new strategic programme, SBI is now working on the following principal areas; health and comfort, energy and environment, building technology and design, housing and building renovation, and processes and innovation.

In May, the National Agency for Enterprise and Construction invited applications for support for research on the transformation and renewal of the construction industry in the following thematic areas: digitalisation of construction, the markets of the construction sector and their function, failures, and seasonal swings and winter construction. This will be associated with other relevant research activities and will be co-financed.

Other players are the Technical University of Denmark, Aalborg University, the Schools of Architecture in Copenhagen and Aarhus, the Danish Technological Institute, and the Benchmark Centre for the Danish Construction Sector.

Finally, it may be mentioned that a fund, Fonden Realdania, was established a few years ago. The aim of this fund is to promote development of construction and the built environment. Each year, the fund has about MDK 400 at its disposal for development initiatives and actual construction projects. The fund has established development centres at universities, which are allocated MDK 25 over 5 years. Examples are management in construction and development of urban areas.

A new cooperative venture, European Construction Technology Platform-Denmark, has been established. 25 firms and organisations have joined in a partnership with the aim to reinforce research in construction, especially cooperation between public and private firms. The aim is also to ensure that the Danish construction sector receives funds from the EU 7th framework programme.

The key areas in the Danish platform are energy and indoor climate, building production (economy and processes), materials, value for the consumer, and urban development.

In the middle of the 80s, the State and the organisations of the construction sector formed a strategic partnership concerning, inter alia, an insurance scheme for supported construction projects, inspections after 1 and 5 years, and rules for quality assurance. Quality assurance was incorporated in State and private construction through the requirements stipulated by clients – see above. Requirements concerning the use of overall economic evaluations and logistics/lean construction were also included.

One evident result has been that the number of defects on completion and subsequent inspections has markedly decreased in the above forms of construction. In the spring of 2005 another joint effort is being prepared to further reduce the extent of failures. The organisations of the construction sector have agreed to take a leading part.

It is also a part of State construction policy that the State clients shall promote industrialised construction. For a large number of years it has been Government policy that, as in other areas, industrialisation should offer opportunities to promote the quality and productivity of the construction industry.

The following projects have started: cooperation among schools of architecture, architectural students and architectural practices/producers on development work, opportunities and obstacles for system solutions, and the use of strategic partnerships in construction (as also in general).

At the Danish Technological Institute, an initiative has been launched to set up a network of firms, construction clients and development institutions which are interested in system solutions.

Norway

Housing stock

In January this year, there were 3,686,525 buildings registered in Norway. Of these, 1,400,727 are residential buildings. There are 2 million occupied dwellings, of which 1.1 million are single-family houses and half a million flats. This is a doubling of housing since 1950. Almost eight out of ten households own their dwelling.

Norwegian dwellings are getting bigger and bigger. In 2001 the average dwelling had 4.1 rooms, an increase from 3.6 in 1980. Single-family houses dominate housing construction. 1,104,641 detached houses are registered; these account for 79% of all residential buildings in Norway.

134,496 buildings are semidetached houses; the remainder of housing are terrace houses, linked houses and other private dwelling houses, blocks of flats and buildings for housing associations. For the country as a whole, there are, on average, 240 single-family houses per 1000 population. Hedmark and Oppland are the regions with the most single-family houses per population, with 361 and 355 single-family houses per 1000 population.

Oslo has only 45 single-family houses per 1000 population, and 2.3 million other buildings. There are 2,285,665 buildings registered for purposes other than residential. Of these, 1,524,393 are recreational buildings, domestic garages, outbuildings etc, while the remaining 761,272 are business buildings.

Of the buildings classified as business buildings, fisheries and agricultural buildings are evidently the largest main group, with 520,648 buildings. Statistics also show that there are 110,003 industrial and warehouse buildings, 42,942 educational, cultural and research buildings, 37,650 office and commercial buildings, and 29,116 hotel and restaurant buildings.

In January this year, there were 374,470 holiday buildings (cottages, summer houses and similar) registered in Norway. Oppland and Buskerud have the most, with more than 40,000 holiday buildings. In relation to the land area of the municipalities, it is the municipalities of Tjøme and Hvaler which have the highest density of holiday buildings.

New construction

Building and civil engineering construction are subject to considerable market fluctuations. From 1966 to 1988, employment increased from about 80,000 to 126,000 in private building and civil engineering construction. In the four years from 1988 to 1992, employment decreased by over 30%, back to the level at the end of the 1960s.

The production index indicates new growth in building and civil engineering construction over the numbers in the 1990s. Civil engineering construction increased up to 2000, but dropped again in the following year.

Land terminal installations for gas and large road projects have provided new growth in civil engineering construction in the last few years. The growth in building levelled out in 2002 but rose again in 2004, driven by large scale growth in housing construction.

In 2004, the number of people employed in building and civil engineering construction are back to a high level, with more than 130,000 employed.

8. Attachments

8.1 Megatrends and driving forces

There is a great variety of megatrends with interrelated implications for housing. The megatrends are changing all the time, and therefore they need constant monitoring in the future. Some megatrends have an effect on national housing projects, others on international business prospects.

Economy

- the globalisation and digitalisation of the economy
- the creative economy

Technology

- the accelerating change of technology (information society, bio society etc. operating as primary driving forces)
- the development, integration and humanisation of information and communications technologies (ICT)
- the rise of biotechnology

Residents and lifestyles

- the growth and aging of the population
- the increase in mobility and interaction
- urbanisation and centralisation
- the individualisation of lifestyles
- the increase in social inequality

Ways of operating

- the necessity of networking
- the desynchronisation of activities
- increasing media attention
- the increase in complexity
- transitional thinking

Geography

- enlargement of the EU and its influence (and the growing role of regions)
- the complex development of the neighbouring region (economic-political development in Russia)

Environment and risks

- exacerbation of environmental problems and limits to growth
- risk awareness and the threat of terrorism
- consideration of ethical and ecological issues

According to megatrends and weak signals, the biggest changes in the housing industry will be the complexity and versatility of housing as well as the globalisation of housing products (concepts for the export of the housing industry). On the other hand, the need for services on a local level will increase. In the future, there will be operators engaged on integrating products and services between consumers and production. A major challenge for urban planning is whether the authorities will enable the increasing diversity of housing products and services.

8.2 Important development factors in the world around us

Likely future events

This is the summary of experiences in Norway, to some extent based on the investigations at Fornebu. The development points to the following challenges:

- Conversion of detached houses and vacant office buildings in high price areas into several households for single people, the old and young families without children
- Construction of landscape features in the form of artificial lakes, islands, harbours etc
- ??
- Upgrading of mechanical services and electric supply with respect to plug&play, IT everywhere, energy conservation, water conservation and ??
- Increased productivity through room modules, industrialisation and mass customisation
- Development of computer programs for personal design of room modules
- Clear division between building envelope and service rooms
- Composites, ??, LED

ICT and technology in housing

Introduction

New consumer demands, a multitude of new electronic services, new technology and digitalisation of signal transmission increase the need for technical installations in housing. The convergence of technology and the industry (IT technology and net infrastructure), flexibility and mobility (e.g. teleworking) set new demands for the design of tomorrow's dwellings.

This note is a brief introduction to a large area, and illustrates a number of challenges faced by the industry in respect of new consumer demands and technology development in the housing of tomorrow.

This will also impact on future construction processes, an area that is not touched upon in this note.

Technology in the housing of tomorrow

In today's housing, three networks are mostly installed: electricity, telephone and TV, the last in the form of cable, an aerial or a parabolic antenna. Digitalisation of the telephone and TV infrastructure increases the service available on the networks, a development and a multiplicity we can only see the outlines of.

ICT technical installations, opportunities and trends

New services and new consumer demands drive technology and the development of technology; Mobility (e.g. home office solutions), entertainment (films, music, games, interactive services, etc), effectiveness (internet banking, remote education/training, etc), and so on, again set new demands for housing and the technical installations.

Technological trends in ICT¹

- ❑ **Development is proceeding towards an open global IP network** where all applications are standardised on IP. The need for open communication solutions will in the long term be

greater than the need for protection which is achieved through closed networks and VPN. Together with cost effectiveness, this will be an important engine of development.

- ❑ **Technology convergence** through IP technology and digitalisation of signal transmission in new and existing infrastructure. Speed and capacity will increase, and the network and form of access will lose importance when the different networks (telephone, cable TV, wireless networks) can all transmit the same digital contents.
- ❑ **Increasing degree of real time communication** with convergence and standardisation on one network for all communication (IP) will enable real time services in sound and picture, and arrange for functionality to be achieved across administrative systems.
- ❑ **The terminal.** PC, mobile telephone etc will be replaced by terminals that utilise the opportunities in a converged network. In order to maximise benefits, interaction points will be implemented between network functionality and terminal. Reliability and a simple user interface, and a more reasonable storage capacity, will be important conditions for success.
- ❑ **Services.** In a developed broadband market, traffic generated in the private market will dominate. A multiplicity of new services will be developed (the costs of actual access will decrease).
- ❑ **Mobility and wireless accesses.** Wireless and fixed networks will complement one another, they will possibly use the same core and distribution networks, and wireless accesses will develop into generic IP accesses. Wireless accesses will be established alongside the fixed network as a substitute for cable networks, and the different wireless technologies will complement one another, and will exist in parallel for the foreseeable future.
- ❑ **Safety in open networks.** Open networks will demand robust clients and network components, and, in the long run, firewalls for private networks will not be able to provide an optimal combination of protection and connectivity. Business critical applications will nevertheless have to act in open environments – between partners and towards customers, and new mechanisms must be created for the protection of business critical traffic and business critical applications.

¹ Source: Telenor prosjekter: Online Homes and Target picture fixed 2005-2010

Substitutes

New alternative and cost effective technologies and services exist at present and are rapidly developed; these are, and will be to a greater extent, additions and substitutes to the communication solutions of today.

Examples are:

- VoIP (hard and soft phones) in preference to PSTN/ISDN
- Messenger via hand-held terminals (ipac) over wlan/wifi instead of sms via mobile
- Skype integrated with Microsoft – its operational system is used everywhere from PCs to mobile telephones
- Businesses with their own/rented networks where all communication takes place over IP (away from PSTN, rented connections, etc)
- Video over MSN

Infrastructure

Electricity networks, telephone networks and TV/broadband networks (cable or wireless) will be supplied to housing in the foreseeable future, even though it will be possible for most digital services to be supplied over either the telephone or TV network (electricity and telephone networks are monopolies subject to consumer licences).

The companies of tomorrow will have to consider several "modules" in the company, linkage of infrastructure and interaction between networks and services. This demands tailor-made piping and cabling for the services and sites/nodes (rooms for technical services) which consider space requirements and flexibility.

ICT services

The companies of tomorrow will have a surfeit of electronic/digital services offered and/or supplied; typical services are

- ❑ Communication solutions (telephony/IP telephony, messenger services, chat, etc)
- ❑ Entertainment (TV, TV recording/storage, games, video (VoD), music, photography, etc)
- ❑ PC, home offices (work, remote education, play& learn, internet services, etc)
- ❑ Automation/safety (control systems, alarm/warning, measurement, care, etc)
- ❑ Community services (information, booking, buying and selling, calendar, etc)

Start of "virtual power plant" field test with fuel cell heating appliances

Fuel cell technology in decentralised power and heating supply for the home enters a new stage today with the beginning of a European field test project. With the focus on how fuel cell heating appliances (FCHA) - networked as a virtual power plant - can be run, a total of 31 Vaillant fuel cell heating appliances have been installed in several European countries and linked with each other via a control centre.

8.3 Research and energy use

Background

For many years, the Nordic countries have made a significant input in research, demonstration and development in the field of energy. The inputs, priorities, players and conditions/cooperation have however been different in the Nordic countries, due to differences in research infrastructure, energy systems and political goals. For instance, Sweden, Finland, Denmark and Iceland have conducted extensive research in large scale thermal systems such as district heating. In the field of district heating, Sweden has conducted a prominent district heating research programme in cooperation with Nordic countries (Nordic Council of Ministers/Energy Research) and within IEA. There are great differences in the interest in co-production of power and heat, for instance in the production installations of the district heating systems. In this field, Denmark and Finland are in a leading position.

Energy use in buildings

In the Nordic countries, the dominant issue is to achieve a sustainable energy provision based on flexible energy. Sweden, Norway and Finland have made considerable research inputs regarding the development of small scale use of bio fuels.

Norway and Sweden are in a special position regarding reliance on electricity in buildings, while at the same time this issue has not attracted full attention until quite recently. Sweden has devoted great attention to the conversion of energy, which has entailed a shift in focus from production to needs, instead of basing the focus on the needs of buildings. Norway has devoted great attention to the effectivisation of electric power in housing. Traditionally, research in the field of energy use in Sweden

has not had strong support. In this field, funds have mainly been channelled through Formas in regard to issues to do with energy use or economic management of energy. Technical issues (e.g. development of technology with regard to building services) have in most cases received support through the Swedish Energy Agency (Stem) or on a co-funding basis between Stem and Formas. In recent years, co-funding by industry of collective research programmes or single projects has increased to 50% of the total research volume. These are seldom free funds, but mostly require the researchers' own input in the form of time or equipment.

Traditionally, research into building services and building physics has been strong in the Nordic countries. As regards expertise, the Nordic area is a world leader in the fields of building services and building physics, but too little of this knowledge is reflected in the building projects carried out today.

This is reflected, in particular, in the extremely high energy use levels measured in newly constructed residential and non-residential buildings.

8.4 Harmonisation of the construction market in the North/Europe

Part of the common legislation of the EU is based on directives which regulate the fundamental safety requirements for a product. In principle, the construction products directive applies to all construction products. The aim of the directive is to facilitate trade in construction products which are to be permanently installed in buildings or civil engineering installations. Technical requirements are specified for

- Loadbearing capacity
- Safety in fire
- Clean water, health, environment
- Safety in use
- Protection against noise
- Energy management and thermal insulation

In certain respects, the construction products directive differs from other directives; examples of these are

- It is not the intention to harmonise the national building regulations
- The essential safety requirements are specified not for the product but for the complete building, which presupposes that the product is used in the way intended by the manufacturer
- Construction products cannot receive the CE mark directly to show compliance with the requirements of the directive; it must first be demonstrated that they comply with a harmonised standard or a European approval.

Harmonised standards are produced by CEN by the mandate of the Commission. Products that are manufactured and whose properties are declared in accordance with a harmonised standard are assumed to comply with the fundamental requirements and can receive the CE mark. A CE marked product can be sold anywhere within the EU (and EEA). However, a CE marked product cannot be used unless it complies with the national legislation.

There are large differences among the national building regulations in Europe. One of the reasons for this is that building markets had often been very regional which resulted in different traditions and rules; another reason is the differences in climatic conditions etc. The CE mark is not a quality mark; it signifies only that the product is labelled in such a way that its compliance with the national regulations can be determined. As pointed out above, it is not the intention of the EU to harmonise the national regulations, and these differences between the regulations will therefore also in the future constitute a real barrier to trade within Europe.

European standardisation work is proceeding at a fast pace, and it is expected that there will be about 2000 standards for construction, a considerable number of which have been completed. The number

of harmonised standards is expected to be about 500, and the first of these, Cement Part 1, was ready in July 2000. In their work on conformity assessment in construction, NICE/Nordtest have committed extensive resources to presenting common Nordic views, e.g. through Nordtest methods and Nordtest technical reports, in order to influence European standardisation work in a direction that is favourable from the Nordic standpoint.

Differences in national legislation are a real barrier to trade in Europe, and this is particularly difficult for small countries such as those in the Nordic area, with very small domestic markets. There is little prospect of common construction legislation being achieved within the whole of Europe within a reasonable period. Conditions should be much better for achieving this within the Nordic area where the countries have similar climatic conditions, a long tradition of cooperation, etc. Common rules and a completely open market should create the conditions for a positive development in construction; longer runs, industrialised construction, innovation, etc.

An important parameter as regards the free movement of products is market control which every EU country is obliged to organise. Market control is important, in particular in creating confidence among consumers.

The population of the Nordic area is just under 25 million. This is small in comparison with the large countries in Europe such as Germany, France, Great Britain, Italy, Spain and Poland. A large and completely open domestic market favours development and innovation. It is therefore also important to involve the Baltic countries in the activities outlined above. Conditions for cooperation among the Nordic and Baltic countries regarding construction should be favourable within a reasonable period. All the eight countries are small, the climatic conditions are similar, distances are small, etc.

8.5 European focus areas for inputs in the field of construction

Two European R&D initiatives are being made in the field of construction:

E-CORE Strategy for Construction RTD (version 2.1) (www.e-core.org)

E-CORE strategy for shaping the future has been produced by E-CORE, the European Network for Construction Research, which has some 80 members, drawn from a wide range of industry and research interests (under FP5). As a whole, the document is a detailed description of focus areas to be developed through the implementation of a number of research themes.

Focus areas:

Meeting environmental requirements
Fulfilling user requirements and aspirations
Changing the construction process
Enhancing construction employment
Exploiting new opportunities in materials and technologies

RTD themes:

- Reducing resource consumption
- Maximising use of renewable energy
- Reducing the impact of construction operations
- Support for environmental tools and strategies
- Understanding and modelling performance
- Creating performance indicators
- Communicating performance

- Whole-life thinking
- Lean production
- Industrialisation
- Integration through partnership
- Application of ICT
- Equipment & mechanisation
- Health and safety improvement
- Nanotechnology
- Biotechnology
- Information and communications technologies
- Natural and traditional materials
- Separation and control
- Durability
- Flexibility and re-use
- Intelligence and responsiveness
- New services

European Construction Technology Platform (ECTP) (www.ectp.org)

ECTP is a European initiative to mobilise the whole construction sector - contractors, authorities, architects and other designers, purchasing bodies, and the full range of suppliers, clients and users - to find a clear set of common priorities (in view of FP7). ECTP, driven by industry players, has identified challenges, drivers, research targets and research themes. The following strategic research priorities have been identified:

Meeting client requirements

1. Healthy, Safe and Accessible Built Environment for All
2. A New Image of Cities
3. Human Friendly Underground Spaces
4. Mobility and Supply through Efficient Networks
5. Transformation of the Construction Sector
 - A New Knowledge-based Construction Process
 - ICT and Automation
 - High Added-value Construction Materials
 - Attractive Workplaces

Becoming Sustainable

6. Reduce Resource Consumption (energy, water, materials)
 - Cost-effective and Eco-efficient Built Environment
 - Efficient and Environmentally Friendly Building Materials
7. Reduce Environmental and Anthropogenic Impacts
 - Protecting Land and Water
 - Impact of Infrastructure on the Environment
8. Sustainable Management of European Assets
 - Transport and Utilities; a European Asset
 - A living Culture for an Attractive Europe
9. Improve Safety and Security

- Mastering Natural and Man-made Hazards
- Security (Natural and Man-made Risks) of Transport/Networks

The European Construction Technology Platform (ECTP) emphasises that a construction sector open to innovation should have the following characteristics:

- Long-term relationships both with the supply side and between supply and client interests
- A focus on performance and costs over the life cycle and away from initial costs
- Knowledge based, with people at all levels able to assess and implement new concepts
- Widely accepted sets of performance indicators
- A network of information and knowledge services

According to ECTP, the mechanisms behind innovation in construction are

- Product supplier initiatives
- Influence of parallel industry sectors
- Individual creativity
- Actions of operators and users

It is considered important to incorporate SMEs into the sector innovation process, and to make use of the flexibility and creativity that is the inherent property of many SMEs. The final project report of CONSTRINNONET (Promoting Innovation in Construction Industry SMEs) presents the results of 3 years' work (2001-2004) (FP5) concerned with SMEs, the innovation and construction sector in 7 countries in Europe. Conclusions:

- No simple solution exists to address the problem of innovation in construction.
- Business support is identified as the most relevant mechanism through which to promote innovation in SMEs in the construction sector.
- European governments and their agents have generally failed to engage with the vast majority of construction SMEs in crucial areas such as RTD and business development.
- At the regional level, where most construction SMEs operate, there is a marked absence of focus on construction in either innovation support initiatives or business development services.
- Data on the construction industry at national and regional levels across Europe is not available in sufficient quality or detail for strategic decisions to be made concerning this economically significant sector.
- New measures to improve business support for construction SMEs include: extending SMEs' resource base through sector-specific regional activities; raising SMEs' awareness of RTD support through brokerage activities; and providing improved SME access to information on national and European measures of support through dedicated entry points.

8.6 The production process

A Danish producer of standard houses such as Nielsen&Bülow (NNC) constructs 600 buildings annually. Boeing constructs about 300 B737 annually. The labour input per m² is the same in a 737 as in a detached house. The construction period is down to 8 days, and in this time materials and components to a value of \$ 1.2m per m² are mounted, compared with DK 6-10,000 in a building. Productivity at Boeing is achieved through a system component approach. Just envisage a building assembled from components in 8 days and being fully finished. There are many who can assemble the carcass of the building in 8 days, but to finish it completely ... Boeing themselves describe how they achieve efficiency. Is this not something that we want to do in the construction sector?

Isn't it just a matter of putting the emphasis on prefabricated components which can be assembled and chosen individually, in the same way as choosing a car of different colours, equipment and fittings? If it is a matter of assembling fully finished system components, for each function of the building, the building may perhaps be completed in a few days. Another possibility is to assemble the

components at intervals, under a climatic envelope, which would enhance the possibilities of individual use of the space around the components and individual appearance, depending on the way they are joined up. Colours and materials must also be optional. When standard modules are used, the consumer is not obliged to buy all components from the same producer. Also, in this way, the building development will not become monotonous. A car is all the time in new surroundings and therefore it does not have the unchanging effect on its surroundings and environment as a house that is not moved or changed so often. It is therefore very important that a building development should not become monotonous.



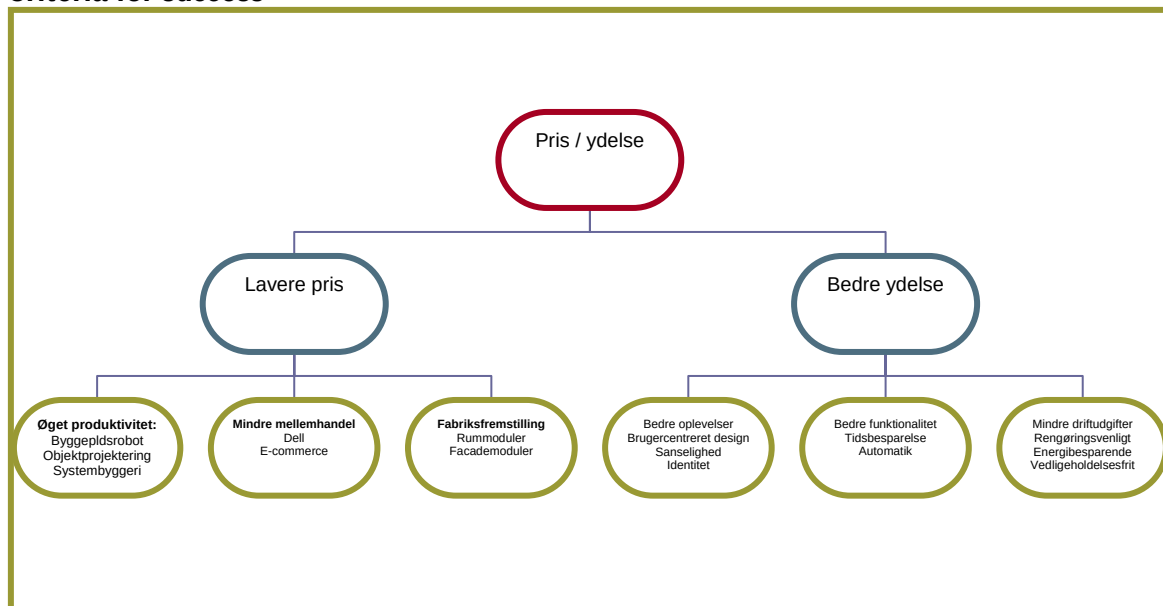
Is such a product at DK 27,000 incl. VAT a bathroom or a building services component? Can we split up our construction process into two parts, one a building envelope and the other an industrial product such as this?

The construction worker of the future

See the films on the website
<http://world.honda.com/run>

Scenarios

Criteria for success



Lower price

Price/performance

Better performance

Greater productivity

Site robots
 Customised design
 System construction

Fewer middlemen

Dell
 E-commerce

Industrial production

Room modules
 Facade modules

Better perceptions

Consumer centred design
 Perception ??
 Identity

Better functionality

Saving of time
 Automation

Smaller service charges

Ease of cleaning
 Energy saving
 Maintenance free

8.7 ERABUILD (www.erabuild.net)

ERABUILD is a new EU initiative which supports European research cooperation (ERA, European Research Area) among national funding agencies in sustainable construction and building management. Eight member countries are participating, and the aim is to develop a common European approach to the sector. Tekes (National Technology Agency, Finland) coordinates the three year project. From Sweden, the Research Council Formas and BIC, Construction Sector Innovation Centre, are taking part. From Denmark, EBST (National Agency for Enterprise and Construction) is involved.

The aim of the ERABUILD project is a gradual increase in cross-border cooperation concerning strategic work, calls for applications for research funds, application forms, assessment, finance, monitoring and reports on results. The objective is to give the players in the sector greater access to new knowledge through international cooperation, and to provide for the research community a substantially greater market to aim at.

A call for applications (May – August 2005) within the framework of ERABUILD concerns those innovation processes that use ICT tools for development (Managing Information in Construction). The projects are to be run among Finnish, Swedish, French and Austrian research environments and sectorial players. Examples of conceivable project areas are

- Strategies for the implementation of ICT
- Implementation of e-commerce
- Storage of, and access to, information during the entire period of consumption
- Interoperability in the value chain
- Validation of ICT tools
- Evaluation of the usefulness of ICT
- ICT for visualisation of products and processes
- ICT for industrialised construction and management functions

Nordic Innovation Centre

The Nordic Innovation Centre initiates and finances activities that enhance innovation collaboration and develop and maintain a smoothly functioning market in the Nordic region.

The Centre works primarily with small and medium-sized companies (SMEs) in the Nordic countries. Other important partners are those most closely involved with innovation and market surveillance, such as industrial organisations and interest groups, research institutions and public authorities.

The Nordic Innovation Centre is an institution under the Nordic Council of Ministers. Its secretariat is in Oslo.

For more information: www.nordicinnovation.net