Concept House
Towards customised industrial housing

Edited by
Mick Eekhout

TU Delft
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Introduction

Mick Eekhout

In the last three decades Dutch housing has evolved from a rationalized on-site industry to an entangled combination of industrial pre-fabrication and on-site industry. The current building industry needs to shift radically to industrialization in order to revitalize the product “dwelling” to match current and future standards. Large industrialization supplies our society with high quality industrial domestic products for small prices. The increasing individualization of the consumer on the other hand caused a change in consumer orientated products, including real estate products like housing. Our research aims at a radical progress in the field of customized industrial housing where the emphasis lies on the individualization of industrialization. The industrial dwelling has to free itself from the restrictions of real estate like building licenses and mortgages, which determined housing projects the last decade on top of the problem of restricted land ownership for project development.

As a technical product the dwelling will form a dialogue between ambitions on the one hand and construction materials on the other hand, which will be selected and optimised according to their functions, abilities and properties. This is in high contrast to the traditional way of building present in the current building industry.

This symposium on ‘Concept House’ has been organized by the TU Delft Research group Concept House. It started at September 1st 2004, as a yearly event to enhance the developments within the research group and to communicate findings on the research field. Concept House is a research group initiated from the Chair of Product Development at the faculty of Architecture, that also encompasses the same Chair at the TU Eindhoven and the Chair of Innovation Processes at the University of Twente. The goal of the research is to analyse the market possibilities, to design and develop new concept houses in a consumer-directed industrialized production method, to build and test prototypes and even to prepare the zero series of production. The duration of the research is from September 2004 to December 2009. Each year the research group organizes a public symposium. This symposium on June 22nd 2005 is the first of a series. We have made a program of speakers from the research group, allied professionals and some outside guests who have shown interest in the subject and who we believe have an important contribution to the subject:

Age van Randen is the eminent professor who has brought Open Building to our faculty in the seventies. He retired in 1991, became active with his Matura system and still has a transparent philosophy on the design principle of ‘support’ and ‘infill’.

Ype Cuperus is the last of the Open Bouwen / Obom researchers, specialized in contemplation of structuring flexibility in the built environment. He is writing his PhD dissertation on an associated subject and hence takes part in the inner circle of the Concept House research group.

Bernard Leupen is a member of the Architectural department and wrote a PhD thesis ‘Frame and Generic Space’, in Dutch: ‘Kader en generieke ruimte’, which touches on an elaboration of the ‘Open Building’ philosophy in a contemporary vision.
He educates architecture students from this point of view. A part of his students are integrated in the research group Concept House.

**Richard Horden** is a high tech architect based in London, famous for several buildings, the smaller amongst them are special houses: the Yacht House, the Ski Haus. He is a professor at Munich Technical University and works with his students continuously on housing projects in extreme conditions, sometimes up to the level of real scale prototypes. We would welcome and expect a collaboration between his group in Munich and the Delft group in future.

**Andreas Vogler** is a Swiss architect, worked together with Richard Horden. Has his own practice as an academic architect teaching in Europe in different places. We have challenged him to contribute to Concept House from his experience and vision in a monograph and later a PhD dissertation. He joined our research group recently.

**Ties Rijcken** graduated with flying colours at the faculty of Industrial Design Engineering in 2004 on the subject of modular floating foundations for housing. He has received 2 awards for his graduation work. Ties joined the research group since April 1st 2005 as the Industrial Designer to finish with a PhD in 2009.

**Henk Westra** has his experiences in the world of 'Housing Associations', in Dutch 'woningcorporaties'. He was president of the SEV, the Steering Committee on Experiments in Housing; is now an associate professor in the Chair of Housing at the department of Real Estate & Housing.

**Joop Halman** is a full professor at the University of Twente on the Chair of Innovation Processes. His inaugural lecture in 2004 was on 'Platform Driven Development in Construction'. He has joined the research group with his PhD student Erwin Hofman.

**Alex Sievers** is senior member of the Inbo office in Woudenberg after his study Architecture and City Development. He leads the research topic 'Town for Seniors' in Dutch: 'Seniorenstad' at Inbo.

**Han Michel** is a former director of one of the most experimental housing associations in Amsterdam 'Lieven de Key' and has experience in this fields in different functions of 15 years. He informs us on his vision on the market requirements of (industrial) housing in the urban environment.

**Sannie Verweij** is the first PhD student of the group since September 2004. She participates from her background as a building technical engineer. She will be with the group until 2009.

**Mick Eekhout** is professor at the Chair of Product Development at TU Delft since 1992, who started this research after having been seduced to this subject by a retired contractor from Vriezenveen, Harry Oude Vrielink, to set up a research project at TU Delft on extreme innovation in housing. He would like to see the end result of the research group Concept House to be a 'bomb' in the housing world.

These persons were invited to prepare lectures. They were kind enough to join my discipline of writing an article in English first and prepare a power point lecture on the symposium, all in short notice, in order to enable us to have a proper symposium book printed for future enjoyment. We acknowledge our gratitude for their efforts and vision. We hope that the symposium will be an inspiring event and this book a long lasting proof of that inspiration.
Towards a customized industrial concept house
Research, development & design for a new generation of customized industrially produced houses in Western Europe.

Mick Eekhout1,2, Kay Verkaik3, Ernst Haagsman3
1 Professor of Product Development, Faculty of Architecture, Delft University of Technology, The Netherlands
www.mickeekhout.nl
2 Director of Octatube Space Structures, Delft, The Netherlands
m.eekhout@octatube.nl
3 Researcher Chair of Product Development, Faculty of Architecture, Delft University of Technology, The Netherlands

Abstract
At the TU Delft, faculty of Architecture, a new research group is active since January 2004, with the first PhD student starting at September 1st 2004 onwards. The group is regularly growing and will exist for 5 years: up to 2010. The aim of the research group is to do a preliminary marketing first, to design, develop and research new Concept Houses, to build and test them as prototypes, to do a final marketing for use in the Netherlands and in Western Europe and to prepare the actual production in the form of zero-series.

The research group has been composed as a multi-disciplinary research group in which urban designers, architects, building technical designers, industrial designers, domotica-designers, marketing people are working together with industrialists and potential clients like housing associations.

Keywords: Industrialization, Customisation, Prototype, Module-build, Component-build; Open Building, System Product, Semi-custom Build.

1. Introduction
Together with food and clothing, providing shelter must be one of oldest society needs. As a profession it is currently called: the building industry. It has a long continuous history of improvement by trial and error, and shows a wide range of cultural, climatic, geographical and economic variations. Shelter, after all, is site related. This complex set of characteristics explains why the building industry is tradition, industry and information at the same time, be it in different gradients, differing from project to project, place to place, time to time.

From the beginning of the industrial age, the advantages of mass production became apparent. Many attempts were made to implement mass production methods in the construction industry. Industrialisation of the construction industry has taken two directions. On-site mass production has resulted in monotonous environments; this can be seen in every metropolis. Tailor made houses, designed by architects have always been in demand, however out of reach for the most of us. The merging of tailor made and mass production of dwellings has resulted in initiatives with mass customisation in the housing industry, ranging from Customized on-site building (North America, Australia) to complete factory built homes (Japan). In the Netherlands there has never been an industry of fully factory made homes.
This is a proposal to investigate the potential of such an industry in Western Europe. Our ambitions are high: the annual manufacturing of 5000 dwellings, to be reached within a timeframe of five years. Then the industry should be viable and if not, the enterprises should liquidate, followed by an extensive evaluation.

The higher goal of our research is to finally boost the acceptance of fully factory made homes on a broad scale. The physical product of our research and development on the long run, industrialised houses, should be a main initiator of this, resulting in a large reduction of on-site building activities from the estimated current 70% to less than 5% of the building process in 20 years from now.

But why should an industry of factory made houses be viable? Although many attempts have been made this has never been the case so far. In order to answer this question, a series of historical cases are shortly analysed and lessons are drawn (see chapter 3). In addition relevant aspects of today's and tomorrows building industry will be explored and should make clear why the making of houses should transform from the making of real estate products to industrial products. It should make clear why an industry of factory made homes is desired (see chapter 4). Once the desirability for factory made homes has been established, we can investigate its global direction and possibilities. In chapter 5 our research & development approach is laid out.

2. Historic Cases of Factory Made Homes

Eight relevant industrial housing projects are documented and analysed (see Appendices 1 to 8) to give an impression of what has been achieved before, why these initiatives stopped and to formulate a feasible direction for further investigation towards a successful and real production of individualised industrialised housing.

What can be learned from the previous attempts to market industrial manufactured housing or systems? In this paragraph the most important reasons of failure of the different projects are listed. Each projects is illustrated with a bomb: the bomb of desired radical change. This bomb is a graphical presentation of the reason of failure. The three letters in the bomb represent the three important areas on which a project can fail.

M : Marketing, the marketing and sales strategy;
D : Design, both the technical and the esthetical areas are taken into account;
P : Production, the manufacturing and producing of the design.

When one part of the bomb is completely coloured the failure of the project is entirely caused by this part of the bomb. When a part only hatched, the project lacked something in this area. A part can also be displayed with a dotted line, this means
that this part is practically missing according to our information and thus not well thought through. Finally the bomb can have a fuse, when a bomb is lacking a fuse it cannot detonate. This means that the project was in fact not very renewing or innovative, and it did not affect the market much at that time. A complete bomb can only be so if every area is well thought through.

1. **Wichita house**

   - The designer Buckminster Fuller kept absolute personal control over every decision;
   - Orders and production were too soon regarding the stage of the design and engineering, which still needed constant improvement.

2. **Lustron House**

   - Banks did not provide mortgages due to the high prices of the prefabricated houses and the unemployment of the old soldiers;
   - The production process was slow and the delivery of steel irregular, therefore an on-time-delivery guarantee could not be given;
   - Some big building corporations opposed the distribution of the Lustron houses;
   - Some states of the USA prohibited complete steel housing.

3. **Habitat modules**

   - Very successful, even after 35 years of use;
   - Strong international publication;
   - Build as a project; architect Safdie was rewarded with many other assignments.

4. **Futuro**

   - The price of plastics tripled due to the oil crisis of 1972;
   - A large order of the Olympic Games in 1980 in Moscow was withdrawn after the boycott of the main western countries of participating in the Olympic Plays.

5. **Fokker woning**

   - The Fokker factory accepted the project to bridge over the recession. When economy started to flourish again Fokker was forced to cancel the project in order to meet the raising demand for airplanes;
   - The product never caught on;
   - Sometimes local authorities did not grant building licences.
6. Esprit house

- Despite good sponsorship the company could not make it, due to failing enterprising spirit or approach;
- Risks were avoided at all costs.

7. Sekisui house

- Transport to the building site was delayed when time progressed and traffic jams increased;
- The appearance does not reveal anything of the completely industrialised fabrication process of the 3D-modules.

8. Matura

- Regardless the great technical advances the product wasn't accepted by the market, especially by the contractors. The profit of the contractors would partly go to Matura, who itself explicitly did not want to act as a contractor.

Of all the 8 examples the only two that were successful were the Habitat complex (built as a one-off project) and the Sesuiki houses, which are very traditional stand-alone houses.

3. Contemporary Conditions

3.1 The Second Industrialization

In the historical examples the emphasis often lays on prefabrication and technology itself. The reasons for prefabrication are rooted in the optimisation of the building methods and do not derive from the customer's side. An extreme shortness of houses was in many cases the driving factor.

In the seventies the first industrialization in the building industry came to an end when individualization in society and in the design of housing complexes came up. The market shifted and was dictated by supply instead of demand. In the last decade the suppliers are hardly producing houses to artificially maintain this (for them profitable) situation. Despite local and temporary shortness of houses, customers have an increased choice in types and prices of houses.

A supply market has clearly other product characteristics compared with a demand market. The Dutch VINEX locations show this. The consumer has more freedom in plan design and different options. Customized building results in serial building of houses, with attention for the individual wishes of consumers. These consumers determine a considerable part of their own dwelling. The combination of mass industrialization and providing room for individual choices and options is common in the modern car industry. This "mass customisation" or mass individualization however is new for the building and housing industry.

Customized building in its current form does not directly indicate industrialization. On the contrary, in the seventies 'jumpyness' in connecting houses made an abrupt end to the rationalisation and prefabrication of building houses with reinforced concrete
components. All concrete industries engaged in this type of building went bankrupt, one after another.

Nowadays we are engulfed by a second industrialization in the building industry, mostly in force due to the shortage of building site labour (strong weather influences cause a bad working environment) surrounded by the bad name of the building industry in general in the eyes of the public. The transition to large scale industrialization in the building industry seems immanent.

On the other side there seems to be a new opportunity for consumer-directed building by industrialization. The consumer wants only one contact person for questions on floor plans, subdivisions, enlargements, guarantees and maintenance. By designing an adequate consumer-organisation, the consumer has one clear contact person or helpdesk. Traditional building is very much fragmented by the many different contractors and subcontractors on the building site, each building on different projects at the same time, dividing their attention to many smaller subjects. This endangers a proper communication with consumers and industry at large.

3.2. Customized Industrialization

Consumer desires like flexibility in plan and extendibility can be answered by industrialization. An impulse was given by the philosophy of the 'Open Building' or adaptable building. The origin was formed by prof. John Habraken (1961): "We should not try to forecast what will happen, but try to make provision for what cannot be foreseen". Adaptability within the framework of housing design means the ability to respond to the current demands and the yet maintaining the flexibility to anticipate future changes. The materialization of a house can be seen in a number of layers, each with a different life span (figure 4). These different layers require each different decision levels.

![Diagram of material organization of a house over a period of 50 to 70 years](image)

Fig. 2. Material organization of a house over a period of 50 to 70 years.

System products like Matura (Appendix v.) fit excellently within the philosophy of individualization and 'Open Building', resulting from the 'SAR'-philosophy of Habraken, set up in the sixties and seventies at the University of Eindhoven. Matura was devel-
oped by prof. Age van Randen and prof. John Habraken in the nineties in their pension time. The applied systems products are all produced in a factory and assembled on the building site.

Total solutions of a high quality in which assembly takes place in the factory are grossly absent. Shifting assembly from the building suite to the factory could result in an increase of finished quality, reduction of building time and going towards an efficient organisation on the building site. The moment and setting of buying cars and sailing yachts indicates this future scheme: one person or organisation lay-outing the individual scheme of the house, offering the sales costs, handing over the house product after installation and mending and fixing possible defects and being the oracle for future extensions and exchange.

One of the levers to be clarified in this research is the transition of the individualized industrial house from a product of real estate (immobile) with all of its consequences of mortgages and building permits onto a larger ‘half-mobile’ customized product. The crucial mix from the consumer’s side is that the average occupancy of houses seems to shorten up to 8 years in the Netherlands, the size of families are being reduced and a growing majority of consumers even lives alone or without children. Especially for this category of house consumers it is hard to find an adequate house with an adequate price in the current recession in the Western European countries. No longer the one family garden house governs the market.

4. Research Approach

4.1. Our Ambitions

Once the desirability of industrial housing is established, we can investigate its possibilities on the short, middle-long and long term. Many aspects need to be balanced, such as location, clustering, urban adaptation, shape, architecture, size and technical composition of the house, production considerations, dimensional and positional coordination, connections, systems and subsystems, choice options, manufacture-build ratio, extensions and completeness of the delivered package (does it include the kitchen, bathroom equipment and finishing?).

For these mainly technical aspects well-considered decisions have to be taken. These choices are influenced by considerations on a multitude of levels. The usual sequence with many feedbacks contain the following aspects to be considered in the research:

- Economical / political aspects
- Social / societal aspects
- Urban design aspects
- Architectural aspects
- Ergonomic aspects of production and usage
- Building Technology
- Formation of production consortium
- Production Technology
- Transport and shipment aspects
- Marketing
- Time schedule of total development in three levels
For successful new products a proper or new market is necessary.

- The **first level** of research is directed to the market possibilities.
- The **second level** is the design of different concept house designs.
- The **third level** is the building and testing of prototypes.
- The **fourth level** is final marketing.

Parallel to the writings of prof. dr. Taeke de Jong we would concentrate on the social desirability and technical feasibility of the customized industrialized houses, but most of all on the design improbabilities. The current market will not generate them by itself. Without a fierce new impulse, even a 'bomb' (a radical change of fashion in housing architecture), cannot generate the probability of a striking shift in the building industry at large in the near future. This is reason enough for Chair Product Development at the Delft Technical University in cooperation with the Eindhoven Technical University to take up this idea and develop a change of attitude towards industrialized housing in Western Europe, in collaboration with other institutes Europe-wide.

![Diagram](image)

**Fig. 3.** The area of research & design is formed by the desirable, possible but improbable (1), Ref. Teake de Jong.

New materials and modern types of houses (E-living) are seen as the boosters of the newly to be designed industrial houses. These can be regarded as the fuse of the bomb. The innovative ideas that attract the attention of both the consumers as well as the industry and form a preliminary marketing analysis (phase 1, figure 8). If our research shows that the design of high quality concept houses shows enough interest (phase 2), the production of 5000 industrialized houses becomes possible and desirable. After that moment the industry is free to translate the results of the research & design of concept house into actual productions (phase 3).
4.2. Target Groups

In first instance the marketing research was directed towards the entire housing market, and subsequently the most fitting marketing share will be identified.

The housing market can be subdivided in the following segments:

- Customer
- Possession
- Use
- Phase
- Environment
- Housing type

The research will be directed in first instance on individual and clustered private houses, with the advantage of development of real consumer products, not necessarily restricted to the Netherlands. Permanent housing seems to have enough demand, although the association with industrial production could be improved. The necessary number of houses in the Netherlands is 60,000 to 100,000 yearly.

As shown in figure 4 we could regard different housing types. The idea is to investigate the best possible market share for future industrial production lines. This flexibility is necessary to design a maximum of different types of concept houses and within these designs a maximum of customisation.

Sannie Verweij will elaborate on the five most favourable Target groups in her lecture in this symposium.
4.3. Design Approach

The totality of problem fields are brought into a 'Flower Scheme'. These are related problems. Each participating researcher is taking one or more typical aspects as the core of his/her study.

A. Social aspects
1. Philosophy
2. Social function
3. Marketing
4. Sustainability

B. Architectural aspects
5. Architectural design
6. Urban design
7. Building permits

C. Technological aspects
8. Structural design
9. Building constructions
10. Choice of materials
11. Building physics
12. Component Integration

D. Design aspects
13. Production technology
14. Transfer of technology
15. Product design
16. Prototyping

E. Product aspects
17. Product development
18. Customization
19. Industrialisation
20. Informatics
21. Process development

F. Realization aspects
22. Production
23. Logistics
24. Finance
25. On site assembly

G. Interior aspects
26. Domotica
27. Interior
28. Energy savings
29. Cables and ducts

H. Psychological aspects
30. Society
31. Individualization
32. Experience
33. Behaviour
34. Mobility

Fig. 6. "Flower" scheme

5. Utilization

5.1. Description of Problems to be Solved

In the 20th century the enormous progress in both aircraft and automobile industries resulted in more advanced materials and manufacturing. Transfer of technology into the building industry will lead to an enormous amount of new possibilities for future housing manufacturing. But to become a real success our newly to be developed customized industrial Concept Houses must have more characteristics than innovatively alone, it also includes:

1. Versatile: freedom of design has to be safeguarded. New industrial design signature in the housing-architecture.
2. **Charisma/identity**: Strong identity by special design of the components and of the composition of spatial components / assemblies of housing complexes.

3. **Comfortable**: Ergonomics of use for the customer as an integral part of the design and development process of the Concept House.

4. **Labour friendly**: Improvement of labour conditions during production and installation.

5. **Environmental friendly**: Responsible choice of materials, constructions, production and transportation energy.

6. **Controlled development**: Serious integrated product development for housing on the long run.

7. **Individualised / Customized**: High degree of choices on component and finishing level.

In order to organize a successful project, both the organizational envelope around the university research & design trajectories, as well as the marketing-directed and production-directed approach of the involved industries will have to be seriously developed.

Only if these factors have been adequately studied and developed the project has ample bearing support to actually contribute towards a full acceptance of industrially produced houses, both by a majority of consumers and producers (phase 1).

This first phase is followed by a totally consumer aimed marketing, sales and realization (phase 2).

Fig. 7. Subjects in study relevant for society.

### 5.2. Organisational Scheme

An appropriate organizational scheme is given by the 'Organogram' (see figure 8) as drafted by Mick Eekhout [1997]. This scheme contains 5 characteristic phases of product development:

1. Preliminary Marketing
2. Concept House Design
3. Prototyping Concept House
4. Definitive Marketing
5. Production & Launching
5.3. Participants

The sponsoring consortium behind the Concept House Research Group is continuously growing and is now large enough the afford two PhD students. Other PhD students and researchers are being paid from TU Delft Impuls Financing to stimulate research.

- Bouwfonds Ontwikkeling
- Inbo bv, Rijswijk
- Isover bv, Capelle ad IJssel
In our strategy a development trajectory and a realisation trajectory are distinct. The chair of Product Development of the TU Delft will lead the development trajectory and has generated a sponsoring consortium of participating companies and industries around this research.

6. Research Group and Planning

6.1. Research Environment
The research of Concept House is embedded in the 6 research programs of the Chair of Product Development TU Delft. See satellite scheme (figure 9).

Fig. 9. Research relations of the Chair of Product Development.
6. Research Team

Table 1
Research team and functions of each member

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. dr. Mick Eekhout</td>
<td>Full professor</td>
<td>project leader TUD/ PhD-promoter</td>
</tr>
<tr>
<td>Prof. dr. Jos Lichtenberg</td>
<td>Full professor</td>
<td>project leader TUE / PhD-promotor</td>
</tr>
<tr>
<td>Prof. dr. Joop Halman</td>
<td>Full professor</td>
<td>Project leader UTwente / PhD-promotor</td>
</tr>
<tr>
<td>Harry Oude Vrielink</td>
<td>Former-contractor</td>
<td>Initiator / contact for the industry</td>
</tr>
<tr>
<td>Ype Cuperus</td>
<td>assistant professor</td>
<td>staff member / marketing</td>
</tr>
<tr>
<td>Dr. Bernard Leupen</td>
<td>associate professor</td>
<td>teaching MSc students Architecture</td>
</tr>
<tr>
<td>Martin Smit</td>
<td>PhD. student TUD</td>
<td>transfer of technology</td>
</tr>
<tr>
<td>Sannie Verweij</td>
<td>PhD. student TUD</td>
<td>Building Technology</td>
</tr>
<tr>
<td>Ties Rijken</td>
<td>PhD student TUD</td>
<td>Industrial Design</td>
</tr>
<tr>
<td>Andreas Vogler</td>
<td>research fellow TUD</td>
<td>Reader on Extreme Housing</td>
</tr>
<tr>
<td>Erik Veeedenburg</td>
<td>PhD student TUD</td>
<td>Airborne Housing</td>
</tr>
<tr>
<td>Jan Timmers</td>
<td>PhD student TUE</td>
<td>Architecture and Townplanning</td>
</tr>
<tr>
<td>Erwin Hofman</td>
<td>PhD student UT</td>
<td>Building Platform Innovation</td>
</tr>
<tr>
<td>Graduate students</td>
<td>Master</td>
<td>small researches</td>
</tr>
<tr>
<td>Dr. Wim Poelman</td>
<td>Associate professor</td>
<td>daily supervision, Domotics</td>
</tr>
</tbody>
</table>

The research will be carried out by a number of PhD- students supported by staff members, post-docs and temporary research fellows and a 'Concept House' laboratory of graduation students.

6.2.1. Infrastructure

The Concept House Research Group has a unique combination of expertise and a long and extensive experience in product development, as well as several national and international collaborations, in such a way that we will be able to apply new input and strategies, which hopefully will lead to:

1. New methods in product development in general;
2. To approach the social question of housing from a non-standard perspective;
3. Specific stimulation of customized industrialized housing in an inspiring way;
4. A totally new industrial set-up to achieve resemblance between the customized housing philosophy and the actual realisation.

6.2.2. Guidance of Personnel

Prof. dr. Eekhout has invited a group of designers, developers and researchers, who are able to create a totally new concept for the future housing market. This group consists of architects, building technicians, industrial designers and industrialists, both on the level of master students, PhD students, post-docs and industrial profes-
sionals. The size of the research group dependants on the totality of financial support to be generated from the research project consortium.

The three TU’s of Delft, Eindhoven and Twente collaborate in this project from the two Chairs of Product Development (Eekhout, Lichtenberg) in view of the future virtual collaboration between the three Dutch TU’s (TU Twente: prof. Halman). The research part undertaken at TU Eindhoven is directed towards systemization, mass industrialization and marketing. The research undertaken at the TU Delft is directed toward overall leadership, design and customized industrialization. We strive for a working liaison with prof. Richard Horden of the TU München.

References

[1] Leupen, B. A. J., Kader en generieke ruimte: een onderzoek naar de veranderbare woning op basis van het permanente, Rotterdam, Uitgeverij 010, 2002

Attention: In comparison to the literature phase 1 and 2 are shifted.
Appendixes
Cases of factory made homes: an historical overview of pioneers
1. Wichita House

Facts
Designer(s): Buckminster Fuller
Product: Wichita house
Place: Wichita, Kansas, USA
Date: 1946
Status: failed, only one prototype was made

Summary
Convinced of massive redundancies in the war industries once the conflict ended and sure of the return of the pre-war housing shortage, in 1944 Buckminster Fuller submitted the plan of adapting the military aircraft factories into facilities for the production of lightweight prefabricated housing. Fuller convinced J. Gaty, senior vice-president of Beech aircraft in Wichita, of the feasibility of producing prefabricated lightweight housing. As chief designer and engineer of “Fuller Houses Inc.” he designed the “Wichita House”. The structural principal is a mast in the middle of the dwelling with a compression ring hanging around it, connected by tension wires. Just after the end of the Second World War the news of the Beechcraft “reconversion” programme had spread throughout the aircraft industry and the first “Wichita” prototype (1945) was universally praised as a masterpiece of design and beauty. Finally it seemed to be possible for innovation and performance to be ignited into the housing market. After the release of the first press reports and photographs 37,000 unsolicited orders for “Wichita” houses were received by “Fuller Houses Inc.”. The “Wichita” house weighted 3,500 kilograms and the production costs were estimated at $1,800 and could be assembled in one day by a team of six men.

Despite the good prospects the project failed because Buckminster Fuller’s fanatical determination to retain complete personal control of the project and refine the house still further before putting it into production (patent was in hands of fuller). Together with the introduction of the shares on the open market the beginning of the final collapse of the company was introduced. After a financial internal battle and a constant delay of the production all orders were cancelled.

Fig. 1. Construction of the Wichita house prototype in 1945 [Pawley, p 105]
Fig. 2. Structural model of Wichita house [Pawley, p 102]
2. Lustron Houses

Facts
Designer(s): Carl Strandlund  
Product: Metal prefabricated houses  
Place: Wichita, Kansas, USA  
Date: 1949  
Status: 2,498 realized before company went bankrupt

Summary
After World War II, The US Government had an interest in creating new housing for returning servicemen. Carl Strandlund obtained a government loan to produce homes of steel with porcelain coated exterior panels, steel framing and steel interior walls and ceiling. He founded the Lustron Corporation and built approximately 2,498 Lustron Homes in a former aircraft plant in Columbus, Ohio. These homes were designed to be maintenance free and were produced in 1949 and 1950. These homes were considered to be three times stronger that a traditional stick built home and were advertised as being rodent proof, fire proof, lightening proof, and rustproof. Despite receiving over 20,000 orders, the company declared bankruptcy in 1950. The plant closed in 1951. Lustron’s slowness to equip its plant and actually initiate production and an inadequate or irregular steel supply may have been partially responsible for the firm’s demise. Marketing experts claim Lustron failed to establish an effective national distribution system to handle its high-volume sales. The construction trades probably worked against the success of a nationally distributed prefabricated, all-steel house. Residential building codes in some municipalities may have discouraged or banned the erection of pre-fabricated steel residential structures. Construction license were therefore hard to obtain. The returning servicemen, who were the main target group, could not obtain mortgages due to their unemployment and where therefore unable to buy a Lustron house. Ultimately, the Lustron’s price may have been the deciding issue. In a pre-fabricated housing market with average prices ranging from $5,500 to $8,500 (land excluded), the two-bedroom Lustron Home model cost $10,000 to $12,000.
3. Habitat modules

Facts
Designer(s): Moshe Safdie
Product: 3D prefabricated units
Place: Montreal, Quebec, Canada
Date: 1967
Status: Realized. A lot of international attention

Summary
Habitat was the major theme exhibition of the 1967 World Exposition in Montreal. It pioneered the design and implementation of three-dimensional prefabricated units of habitation. 365 construction modules connect to create 158 residences ranging in size from 600-square-foot one-bedroom dwellings to 1,800-square-foot four-bedroom dwellings, exhibiting fifteen housing types in all. Stepped back in their modular placement, each residence has its own roof garden (located on the roof-top of an underlying residence). This environmental feature of Habitat expresses the architect’s life-long commitment to creating salubrious and dignified living environments. Today some inhabitants even combined 2 x 2 modules.

Children’s play areas are provided throughout the project. Three elevator cores direct vertical circulation throughout the complex, with elevators stopping at every fourth floor to serve pedestrian streets. Every part of the building, including the units, the pedestrian streets, and the elevator cores, participate as load-bearing members; units are connected to each other by post-tensioning, high-tension rods, cables, and welding, forming a continuous suspension system.

Fig. 5. Cross-section of dwellings
Fig. 6. Steeped back placement of the 3D-units provides exiting architectural compositions
4. Futuro

Facts
Designer(s): Matti Suuronen
Product: Futuro, ski cabin (also used as holiday house)
Place: Janakkala, Finland
Date: 1968
Status: only 20 copies were manufactured and spread over the world

Summary

Matti Suuronen was assigned to design a modern ski cabin in Janakkala, central Finland. The difficult terrain dictated certain design principles: lightweight, easy to assemble and easy to transport. Suuronen designed a elliptic sphere made of sixteen insulated sandwich panels of glass-reinforced polyester with a polyurethane insulation. The sphere is placed on a steel ring, which has four legs. The Futuro has elliptic windows and an aircraft related door, which unfolds and forms a stair.

Since the Futuro was designed as a ski hut therefore a net floor surface of 25 m$^2$ (and a volume of 140 m$^3$) was sufficient. The interior consists of a hall with storage space, a compact bathroom with shower and toilet, a pantry, a niche with a two persons bed and eight build in chairs, which can unfold into a bed and a fireplace with grill forms the centre of the dwelling.

After the third copy of the Futuro Polykem decided to take the design in manufacture. Inspired by the success of Futuro Suuronen design another series of plastic buildings under the name Casa Finlandia. According to Polykem these buildings could be used as a (holiday) house, kiosk, motel room, filling station, car wash tunnel, café and bank office. Despite international attention the Futuro Casa Finlandia never became a commercial success. Two reasons could be mentioned for this failure:

1. The oil crisis of 1973 caused the price of plastics to triple;
2. A large order for the Olympic Games of 1980 in Moscow was cancelled due to a lack of funds after the boycott of the USA, Japan and parts of Western Europe. (caused by the Soviet Union raid in Afghanistan)

Fig. 7. Exterior Futuro [Melis, p 39]
Fig. 8. Interior Futuro [Melis, p 42]
5. Fokker Dwelling

Facts
Designer(s): Johan Schepers
Product: (complete) dwelling
Place: Fokker plant, the Netherlands
Date: approximately 1968 till 1975
Status: all additional work next to aircraft building was aborted due to an increasing demand for aircrafts

Summary
At the end of 1968 aircraft builder Fokker decided to expand their assortment and develop dwellings. The dwellings consist of stiff box shaped modules (5.4 x 5.4 x 2.7 meter), which form a dwelling on their own or connected together. These boxes could be placed in a steel construction frame, which allowed the modules to be relocated and thus the dwellings to enlarge or to shrink. The structural design (a flexible steel skeleton), the modules (made of polyester sandwich panels) and the infill are strictly separated. The detailing of the modules was determined by:

1. the demand of Fokker to make as less reveals as possible and
2. the present production machines of Fokker for making sandwich panels.

March 1975 Fokker was able to get an allowance to take the experimental dwelling in production, the opposite however happened; the program was aborted. At that time the aircraft industry was doing very well and therefore was decided to cancel all additional work.

Fig. 9. Montage and placing of a module. Fig. 10. Dwellings stacked together to a condo.
6. Esprit House

Facts
Designer(s): various designers
Product: (complete) infill system
Place: Zoetermeer, the Netherlands
Date: approximately from 1985 till 1995
Status: never realised

Summary
The Esprit house is a total infill system thoroughly consumer oriented, for existing as well as for new housing projects. During the project an entire assortment will be assembled and produced, three different stages can be distinguished in the Esprit project:

**Esprit 1: study 1985/1986**, market research for user demands done by experts of the Erasmus University.

**Esprit 2: design 1987/1991**, together with six companies a couple of prototype houses were built in Zoetermeer. Assembling and integration of electric, communication and security installations are the keywords of this phase. Also a start was made of the development of a plug-ready kitchen block.

**Esprit 3: the future 1992/1995**, Seven different infill systems exist:
Plumbing; kitchen; heating; ventilation; space partition; energy, communication and safety (ECS); façade systems.

The bearing construction and foundation are not part of the above list, its limiting conditions however are taken into consideration. Besides the bearing construction the consumer is able to choose the entire interior within the comfort limits of social housing. The esprit system is designed from the consumers' point of view to be able to formulate an adequate answer.

Fig. 11. Simple and fast montage [Eger, p 7]
Fig. 12. Skeleton and the infill [Eger, p 13]
7. Sekisui House

Facts
Designer(s): Sekisui House
Product: complete prefab dwellings
Place: Japan
Date: started around 1950
Status: commercial success; in total 200,000 prefab dwellings a year of which Sekisui produces 50%.

Summary
The first mass production based Toyota factory was opened in 1937. Eight years later (1945) the Japanese car manufacturers concluded that the Japanese market was no longer suited for the mass-production that was generally used in the USA. The Japanese market is smaller and demanded more individualisation. This resulted in many small companies being able to switch production very rapidly. In 1950 Eiji Toyoda and Taiichi Ohno, two young engineers, visited the USA for studying the production of cars. This visit laid the future base for consumer aimed production in Japan. At first in the car industry but then also in other industries, including the building industry. Around 1950 Sekisui Chemical Company started the production of complete prefab (3D modules) dwellings, using the gained knowledge from the car industry. The present Japanese building market exists of 20% complete prefab dwellings, of which Sekisui House makes 70,000 to 100,000 a year. Compared to the traditional building industry there are five main differences:

1. Customer-oriented: together with the customer the entire dwelling is talked through like currently is common in the kitchen industry.
2. Construction time: can be determined very precise (the on-site building time is only 50 days).
3. Quality: the prefab houses have a very high quality. In the factory the quality can be guarded precisely, what enables good feedback in case of production errors.
4. Working conditions: are always similar, no weather influence.
5. Transport: On average 15 trucks are needed for the transport of all modules of one house. Regarding the current traffic problems the transportation of air is a big disadvantage, in fact traffic jams increase the building budget.

Fig. 13. Sekisui House prefab roof fabrication [Beemster, p24]
Fig. 14. Japanese prefab dwelling, Sekisui House [Beemster, p24]
8. Matura

Facts
Designer(s): Prof. Age van Randen and Prof. dr. John Habraken
Product: Matura (infill system)
Place: Delft, the Netherlands
Date: approximately 1990
Status: failed, taken into manufacturing but went bankrupt.

Summary
This system relies on the fact that all installations belong to the infill (except for the main supply and return ducts). Together with a suitability of the system in the existing houses a viably starting point was created. The system divides the different ducts in different zones, layered above each other. The layered zones allow the ducts to cross each other and thus make a free distribution of ducts possible. Every appliance has its own supply and return duct to or from a distributor at the relevant main source interface. These main source interfaces can be positioned freely in the support, what makes a concentration (shaft) unnecessary. The combination of floor tiles and hollow base profiles create a matrix in which the ducts can be laid. This matrix provides a freedom of position for arrangement.

Regardless the great technical advances the product wasn’t accepted by the market, especially by the contractors. The profit of the contractors would partly go to Matura, who itself explicitly did not want to act as a contractor. Therefore contractors weren't interested in the product, by applying it they would partly loose their profit.

Fig. 15. Matura infill system
Fig. 16. Details of Matura infill system [Vreedenburgh, p 108]
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8. Matura
The Power of an Idea

Age van Randen
Emeritus professor Delft University of Technology
agevanranden@wxs.nl

Abstract

Habraken's book "Supports- an alternative to mass housing" (1962) opened up a whole new way of looking at housing. The SAR was founded and proposed decision-levels along the lines of Support-Infill, giving again a clear role to housing occupants. In the years following a lot of experimenting on the basis of the SAR proposals was done. Later the Foundation for Open Building and OBOM (1984) were founded, aimed at making the SAR proposals practicable. In the beginning of the nineties an ambitious attempt was undertaken to develop an industrialized infill system called Matura. The ins and outs of this attempt are described as they give a good insight in what is involved in such an innovation. At the end an overview of products now in the market and all aimed at making infill viable is given.

1. The SAR

In 1962 "Supports - an alternative to mass housing" by John Habraken was published. Thereafter a group of Architects offices and the BNA founded and financed the SAR (Stichting Architecten Research). Later quite a group of contractors joins in. This was the beginning of a movement aimed at restoring active participation of housing occupants in the housing process, so in fact against mass housing. At the end of the sixties- beginning of the seventies a set of decision levels was defined by the SAR, aimed at a clearly structured decision-making process in housing, in short: who decides what. The housing occupant got a well defined level of his own, the infill level (figure 1).
On the basis of these levels a method was developed to enable an effective design process for tissue-, support- and infill-level. Initially the central problem to be tackled was: "how to design a support?". Architects were used to design an ideal dwelling layout and then multiply it, and so were builders. But designing a support meant to design capacity; in other words future possibilities. SAR proposed using zones and margins to systematically tackle this new design task. Parallel, a set of coordination rules for position and size, based on a tartan grid of 10-20 cm was introduced, in fact also zones and margins. In 1970 PLAN, monthly of the BNA, published the first results of the research work done by the SAR, illustrated by examples of real life projects (PLAN 3-1970). In 1973-1974 2 issues were dedicated to a whole set of real life projects (PLAN 12-1973 and 1-1974). It clearly illustrated that quite a number of architects offices, building companies and prefab companies experimented with the SAR proposals. In the seventies SAR started to publish the Quarterly OPEN HOUSE: a platform for discussion and disseminating ideas.

2. Nodes and Noodles

One of these experimental practices was my office, Van Tijen-Boom-Posno-van Randen in Rotterdam. We did extensive experiments in quite a few projects and experienced great difficulties in overcoming the many interwoven decisions embedded in normal practice. In my inaugural speech as a newly appointed professor in 1974, named "Nodes and Noodles", I called it the noodle-effect. This effect especially surfaced dealing with the many service lines connected with almost any wish of the occupant to position something in a certain place. In those days (and still) all these service lines were to be embedded in the concrete structure, meaning that these decisions had to be made in a very early stage of planning, too early from the point of view of the future inhabitant. An illustration going with my inaugural speech and still valid, visualising this problem in figure 2.
In the following years, my chair (Architectural Technology) has given ample attention to look into the possibilities the SAR proposals offered to master the problem. Together with the SAR and the Building Centre in Rotterdam and in very intensive cooperation with all parties in the building process a new concept for Modular Coordination was developed on the basis of the SAR 10-20 tartan grids.

3. The Foundation for Open Building and OBOM

In 1984 the Foundation for Open Building was founded, stemming from the wish to visualize the intensive cooperation between architects, builders, sub-contractors, suppliers of building components and the research institutions. The aim was to promote consumer oriented building in housing. At the Faculty of Architecture of the Delft University of Technology, the OBOM (Open Building Development Model) was founded, a research unit aimed at further developing the practicability of the Open Building ideas.

4. NEN 2883 - Modular Coordination

In the eighties quite a lot of attention was given to the development of the 10-20 concept for Modular Coordination as mentioned earlier. This concept was especially preoccupied with what we called the building-node, being the place where many components and thus decisions had to be brought together, so coordination would be beneficial. Not sizes of components were central in this concept but coordination of position, sizes being derived from that. It also aimed at enabling working from global to specific, an important feature of the design process. Moreover it had to enable independent decision-making by the many parties involved.

Many workshops were held with people working in all fields of the building industry in order to ensure that the proposals were practicable. A model was developed to ensure a systematic approach of all building nodes in housing. People from the building practice could contribute their solutions into the model, the model visualizing the interdependencies and the coordination problems involved. The result was a concept for a new standard for Modular Coordination, NEN 2883 (figure 3)

In those days some architects launched the idea that Modular Coordination was outdated by the computer. Their assumption was that each component could be made at any size by computerized machines. It never occurred to them that not size was the crucial matter but coordination of position. Nevertheless the standard, because of this, never became a definitive standard. Now I hear complaints that the computer does not solve the crucial matter, something which was clear from the beginning I would think. Yet we had failed to be convincing.

5. Building Regulations

Existing Building Regulations made it impossible to get a building permit for a support without exact plans for the individual dwellings. This was frustrating the development of supports enabling later infill plans. OBOM and SAR were involved in formulating a new building code. In 1992 this resulted in the so-called “Bouwbesluit”, enabling free geography of the houses. A SAR and OBOM proposal for a separate building permit for each level was not granted.
6. Market segmentation

It's obvious but still I want to mention it: the separation of Support and Infill is first of all a decision-making tool and as such enables a very effective market-segmentation as illustrated in figure 4.

Two distinct and separate products

SUPPORT:
- many public aspects
- bound to land
- political decision making
- many regulations
- wind & weather

market: - institution clients

INFILL:
- not bound to land
- no political decision making
- controlled climate mounting

market: - the individual consumer

Fig. 3.

Fig. 4.
7. Infill Models

The need for a totally new way of making the Infill became increasingly obvious in order to make the SAR proposals for separation of Support and Infill become practicable. The diversity of the wishes of inhabitant was in conflict with normal practice in building, based as it was (and is) on quantity production. Moreover these wishes had to be decided on in a very early stage and were than for ever being embedded in concrete.

OBOM proposed 6 models for different concepts for Infill. They dealt with techniques to make all service lines part of the Infill. Partly they proposed means as part of the Support, e.g. open channels in the construction floor later to be covered. Other models aimed at making the service lines an integrated part of the Infill system, i.e. a raised floor or a suspended ceiling. The advantage being that such systems could also be used in renovation of existing "supports", broadening the market for such systems. Two models are pictured in figure 5.
8. The MATURA Infill-system

To illustrate what is involved in putting an Infill system into the market here follows a story about the development of the Matura Infill system. Habraken and I were, after our retirement, deeply involved. The aim was the development of a consumer orientated, industrialized infill system.

The following objectives were formulated:

- freedom of design for the occupant
- fitting in new as well as existing dwellings
- a total infill including all services
- per house production, every infill a separate product
- fit for production with the most modern industrial means, among others integrated data-processing and data-steered production

The challenges were:

- an immense variation in design
- every individual infill penetrates into the whole process of sales, design and production
- each infill very complex with hundreds of components and details
- time lap between design/ordering must be very short
- necessary high quality consumer good necessitates a flawless process

First of all something about the chosen technical solutions (figure 6 and 7):

For the service pipes and conduits a raised floor with a base-profile on top of it is provided. The raised floor exists of polystyrene pressed matrix tiles with grooves in top and bottom, the smaller top ones for water and heating pipes, the bottom ones for sewage, ventilation and gas pipes. The hollow base profile is for electrical and
electronic conduits. Where (door)-openings are planned both ends of the base-profile are connected with a hollow profile embedded in the cover-floor (2 x 10 mm fibre gypsum board). Sockets can be mounted in the base-cover or in the wall on top of the base-profile. Switches are wireless.

On top of this so-called "lower system" walls, doors, sanitary equipment etc. etc. are mounted, together called the "upper system" (see figure 7 above).

The upper system may exist of off the market solutions, but may also comprise specially developed products aimed at making the system more flexible and of higher quality. The total infill system can serve as an innovation platform and be kept up to date.

Just to give an idea what is involved in developing such a system a few illustrations: figure 8 and 9.

For several service pipes special solutions had to be developed.

First of all the decision was made to give each sanitary appliance it's own piping to a central point. This because branching off demands a bigger diameter and causes whirling. On top of that it makes decisions about each appliance independent from other appliances.

For sewage pipes the normally prescribed diameters would make the raised floor too high. In analogy with the so-called "sucking system" for rainwater-drains, a "full fill" horizontal system was developed. It has small diameter (40 mm) pipes without branching off. The system was tested with very good results, so an official license was granted by KIWA. Later on it was licensed in Germany and Japan.
For the ventilation ducts a flat pipe was developed, 40x200 mm. Experts predicted it would not work because of too much whirling. With Stork, a producer of ducts, an intensive testing program was executed. This resulted in new horizontal and vertical 90° turns with small guides. The performance was as good as normal round pipes of 12 cm diameter. These new pipes can also be fitted into separation walls.

For the electric wiring a push and fit system was wanted for reasons of prefabrication and easy fitting out by anybody. In Germany the Wieland system was found, but it had to be altered for use in dwellings, which they did. It is now widely used.

9. The Matura software

From the start the need for very good software was clear to all involved. This software had to enable an integrated process of sales, design, pricing, contracting, ordering, storage-management, production, transport, delivery and after-sales. It was developed in-house and was based on what was called the fast-track design process. Its spine was a very extensive generic database with a library of components and details from which each design could be built up in the project based database with automatic generation of all needed for the client contract and production.

It was possible to give an instant price when the client was satisfied with the design, meaning that instant changes could be made if he wanted to spend less or more money.

As soon as the client gave his o.k. all following steps were ready: ordering on-line with delivery time at the distribution-centre, planning for prefabrication of all parts in the distribution-centre, all work-instructions and necessary drawings, the packaging-lists for the container, the assembly instructions and drawings for on site. The software was also prepared for data-based machine-production, needed at a certain production-volume. Figure 11 shows the design made with the client, figure 12 shows all the generated technical systems in one drawing (normally many different layers).

10. The Distribution-centre

Central in the logistic organization was the distribution centre. Here each individual infill package was prepared on the basis of computer generated instructions and drawings. All components were prefabricated or cut to size, after which a computer generated sticker was added with a code coinciding with a code on the site assembly drawing assuring that each part would be assembled on the right position. After completion all components were packed into a dedicated container. This container was transported to the house of that specific client where 3 specially trained assemblers did the fitting out in 10 days, including all services. They were the only people in the house during this assembly process and therefore could be responsible for the final delivery to the client. This was for the building industry a true innovation, assuring a quality job.

11. Final remarks on Matura

Infill systems like Matura make it possible to sell parts of the support per m², thus providing a flexible marketing possibility A prerequisite is a clever design of the positioning of stairwells and stacks in the support (see figure 12).
all resulting technical layers printed on top of each other

Fig. 11.

client design

Fig. 10.
For renovation of apartments Matura enables individual renovation per apartment at a chosen moment e.g. when somebody moves out. The renovation of the outside of the block can be done apart from the inside. In Voorburg this was practised: new stairwells and a lift were added with new balconies in a separate building process. The apartment renovation was done when a tenant moved out and the new tenant could chose his lay-out. It was called "renovation per mutation". For this project Matura, together with all partners, was awarded the Building Innovation prize in 1995.

In total about 50 dwellings (part of them in the renovation project) have been fitted out with the Matura system from a pilot distribution-centre. But when up-scaling became necessary it turned out that financiers were not willing to invest, meaning the end of the venture. That was in 1996. This meant that the promising next fase of systematic improvement using the Lean concept construction could not be executed. Only the software has survived, Arpa-Intrabouw is very successfully in selling it to building-specialists, prefab producers and the like. Despite the end of Matura I would not have missed the experience and this goes for all involved. I do hope others will benefit from the experience, we were too early, timing may be better now.

12. State of the art now

Development of products enabling a separate infill has gone on, stimulated by the IFD (Industrial Flexible Demountable) program of the Ministry of Housing. Just to name a few:

- **The Betonson Wing System**, a concrete prefab slab floor with open channels for positioning of ducts and conduits. They are then filled with foam concrete.
- **The Infra+ floor**, a prefab floor specially designed for a free lay out of services. Afterwards a coverfloor is mounted.
• The VBI Flexcasco, a prefab support with open channels in the floors and at every 60 cm in the walls tube-like channels for vertical electricity conduits. The walls can also be provided with recesses for conduit base profiles.

• The Slokker house, services are all mounted against the ceiling, covered with a so-called Stretch-ceiling.

• The Nijhuis Trento house: a thoroughly systematized production method for individualized housing.

• All the above mentioned systems are for newly built housing only.

• Base-profiles; in an IFD booklet special attention is given to base profile solutions. Five new base profiles now on the market are mentioned. Some have to be part of an infill system, others can be mounted afterwards, Only one has a systematic solution for (door-) openings in walls.

• The FAAY Light mountable separation wall units with tube-like channels for vertical conduits at every 30 cm. They can easily be reached by boring a hole. The wall units can be mounted very well on top of a base profile.

• Geberit GISeasy system for easy installation of sanitary appliances

So far the new products. Worthwhile to mention is that Bouwfonds, an important developer, is experimenting with separate contracts for Support and Infill. The price of the support turned out to be 30% below estimate, for the infill still no satisfactory solution is available.

Also interesting are the ongoing experiments in Japan, Finland, Switzerland and USA. The CIB Working Group W 104 on Open Building organizes regular congresses for exchange of experiences.

13. Conclusion

These are all valuable contributions and at the same time a challenge to go on with further innovations to enable real consumer-orientated housing of high quality, also in architectural sense. I am convinced the Support-Infill concept can still be one of the inspirations for developing Concept House ideas. Specially the development of clever supports aimed at variety of choice in m²’s and in architecture, and of innovative infill aimed at starting an infill industry and opening up a personalized market, also covering the huge market for renovation, can be fruitful to my opinion.
Thoughts on Mass Customisation in Housing
Inspired by Japan

Ype Cuperus
Assistant Professor, Faculty of Architecture, Delft University of Technology, The Netherlands.
y.j.cuperus@bk.tudelft.nl

Abstract
Concept House is a multi-facetted project that is still expanding in its ideas and ambitions. Design, design research and research by design are strategies to be applied. In order to apply a bit of lateral thinking, designers need inspiration. This paper gives a brief introduction to the concepts of Open Building and Lean Construction to structure some observations of the Japanese society and housing industry. It connects the housing industry to the client, research to housing and lean to manufacturing. In Japan they solve problems by looking for inspiration, in the world in the Netherlands and in Delft. Curiosity helps.

Keywords: Concept House, Open Building, Lean Construction, mass customisation, housing, Japan.

1. Introduction
'We should not try to forecast what will happen, but make provisions for what cannot be foreseen'. This is one of John Habraken's finest quotes, from his first book 'Supports, an Alternative to mass housing, from 1961. [1] There is little point in trying to predict the future; we all know too many examples of well-intended totally wrong predictions. But even making provisions cannot be done without an idea about where the future leads us. We could design scenarios, possible futures, to focus our provisions on. One way to make scenarios is to look at other cultures, economies, countries, societies, or even: times. In many respects Japan meets most of the requirements for a scenario that is valid for our Concept House project. In order to put the Japanese observations into the right perspective, first the concepts of Open Building and Lean construction are described, since these are leading principles for the future construction industry. Some elements of the Japanese housing industry are highlighted, the research and development tradition in Japan is characterized and some examples are given of product development. In the final analysis it is concluded that Japan is so inspiring because the Japanese have an open mind to be inspired by other's ideas.

2. Leading concepts
When being in Japan there are many things that strike the eye. The food is great and the trains run on time. In order not the get distracted too much, this paragraph gives an introduction to two concepts, Open Building and Lean construction, as a guidance to mass customization in Japanese housing.
2.1 Open Building

The raison d'être of Open Building can be expressed in terms of care, responsibility and technology. People, who care about the environment they live in, will make it a better and safer place. Therefore the built environment must encourage people to take responsibility for their own territory. An environment that clearly distinguishes those spaces and parts of a building for which occupants should take responsibility, will address the user's needs to feel responsible. Therefore a building should be designed and built in such a way that both spaces and parts of the building can be clearly allocated to those parties and individuals that should take responsibility for them.

Buildings, which are designed and built with separate systems, can create conditions for responsibility and care. Therefore the subdivision of the building process needs to reflect the lines of decision-making and the definition of responsibilities between the parties. This subdivision can then be translated into specifications for connections between building parts. This in turn creates buildings that can be modified and taken apart again.

It offers the basis for a well-structured building process with well-defined interfaces. It allows us, to at least partially transfer the construction process from building to manufacturing. It is the key to reducing waste by co-ordinating dimensions and positions instead of improvising on site by cutting to size. Applying information instead of energy.

This is an important condition to re-use building parts, thus extending the lifetime of building parts, without the waste of dumping and recycling, coinciding with degradation and the use of energy. [2]

2.2 Lean Production and Lean Thinking

Lean construction is a construction management concept that originated in the late eighties of the past century. The American and European car manufacturing industry was in a deep crisis and saw their market share decreasing, while the Japanese carmakers took over. Research of the IMVP (International Motor Vehicle Program) made clear that car manufacturing in Japan had deviated from America, which had always set the example with mass production of cars. WWII had changed the word and Japan faced import as well as export restrictions. The local market was too small for mass produced cars, such as the T-Ford and the Volkswagen Beetle. They were forced to look into ways how to assemble different cars in small production runs on the same production line. Toyota was the first in successfully adapting car manufacturing American Style to the Japanese circumstances. The change-over time of the production line was considerably reduced, long term relationships with sub contractors opened the way to just in time delivery and the relationship with the end users were vital in determining future car programs. This became known as TPS, the Toyota Production System, or in more general terms, 'Lean Production'. This is very well described in 'The Machine that Changed the World'. [3] These ideas caught on and there is no manufacturing industry, these days, not applying one of these ideas involved. The adoption of Lean Production was not limited to the manufacturing industry, many others, like services industries such as the travel, healthcare, financial, telecom and energy industry, to mention a few, are not 'lean' at all. The house building industry was mentioned in the same category. Lean Production guide lines were described in more general terms as 'Lean Thinking'. [4]
It can be summarised in five steps:
- **Value**: determine what the customer (end user) expects as the added value;
- **Value Stream**: deliver the wanted added value;
- **Flow**: optimize the production process;
- **Pull**: optimization of the production process is directed by 'pull', the clients wishes, rather than 'push': selling products, not asked for;
- **Perfection**: continuous improvement. [2]

### 2.3 Lean Construction

Lean Construction is inspired by Lean Production and aims to apply lean thinking to the construction industry. The basic principle of 'lean' is to reduce waste: 'specifically any human activity which absorbs resources but create no value'. [4] (Womack, Jones, 1996, p. 15). 'Lean Construction results from the application of a new form of production management to construction. Essential features of Lean Construction include a clear set of objectives for the delivery process, aimed at maximising performance for the customer at the project level, concurrent design of product and process, and the application of product control throughout the life of the product from design to delivery'. [5] [2]

### 2.4 Open Building and Lean Construction

A superficial comparison of Open Building and Lean Construction suggest that they have much ground in common. They both originate from dissatisfaction with traditional second wave industrial production that was felt at approximately the same time. The principles of lean production were first adopted in the early sixties in Japanese car manufacturing. At the same time discontent with mass housing of the post war-housing boom in The Netherlands resulted in the introduction of different levels of decision making in the housing industry. The base building ('support') and fit-out ('infill') were treated as separate entities, with different life cycles, in order to build an environment that can respond to individual needs of the dweller. Open Building is a multi-faceted concept, with technical, organisational and financial solutions for a built environment that can adapt to changing needs. It supports user participation, industrialisation and restructuring of the building process. If change is the problem, a layered organisation of the building process can provide at least a part of the solution. Positional and dimensional co-ordination of building parts and their interfaces are a tool and a condition for industrialisation and probably a leaner construction process.

Open Building and Lean Construction can complement each other, what they have in common is the sympathy they feel towards lean thinking. Open Building is concerned with the quality of the built environment and the way it is established, from initiative, via decision-making, design, construction and real estate management. 'Lean Construction rests on production management, the "physics of construction"'. [5] [2]

### 3. Get inspired by Japan

This paragraph touches upon some aspects of the Japanese housing industry. It gives an idea how to communicate with potential clients, how to conduct research and development, how to manufacture and how to develop new products.
3.1 Facts and figures about Japan.
For a better understanding and a proper interpretation of Japanese observations a basic knowledge of Japan helps. The following facts and figures are rough, nevertheless sufficient for a general understanding. Anything in Japan is ten times as big as the Netherlands. In terms of size, Japan is ten times the Netherlands, however, the inhabitable area is relatively smaller: The urban concentrations are situated along the coast, since most of inland of the country is consists of mountainous landscape.

The number of inhabitants is 127 million, occupying 46 million dwellings. The housing production is 1.4 million. This is roughly twenty times as much as the housing production of the Netherlands. This difference is accounted for by a currently low housing production in the Netherlands on the one hand and the average short life cycle of dwellings of 26 years in Japan on the other hand. 37% of the Japanese dwellings are owner built, most of the times as catalogue houses of some kind. 20 % of the manufactured houses are based on 3 dimensional elements. [6]

3.2 Consumer oriented housing in Japan
In Japan, usually the block of land for a dwelling is family owned and is passed on from generation to generation. Contrary to the Netherlands, living in an old house gives little prestige; anyone likes to build a new house, from time to time. This fits in the tradition of timber framing, in which newly construction is as simple as major maintenance. This in turn has resulted in a related housing industry with appropriate selling channels. First the client selects the way he wants to inform himself. He could visit an exhibition village either built by a large supplier, showing his range of houses or by small companies, who have shared their forces and present one house per supplier each. Inside the exhibition homes, information can be obtained, from a sales representative or by means of brochures. Once the attention is caught, it is important to turn it into a relationship with the potential client.

Fig.1 exhibition village in Nagoya

Apartments in high-rise buildings are also presented as exhibition homes mock-ups in existing buildings. They are advertised in newspapers, though flyers or by billboard men, who will organize a taxi to the exhibition flat, if you show interest.
Although all suppliers interviewed say that they bind the client by the quality of their product, they all reluctantly admit that the client is attracted first by their reputation, however a trustworthy impression of the sales person is just as important. This is the key for a second visit. If the client cannot relate to the sales person, he will not return.

Brochures are important means of communication; they can convey the quality of the house to build. Brochures are also used to communicate lifestyle to address the preferences of the potential client by painting different atmospheres. Does the client like 'natural', 'modern', 'classic' or 'elegant'? Lifestyle brochures are used to relate the client to the house as well as to determine the client's wishes and desires. Before the contract is signed, twenty sessions may have taken place, to take all decisions needed, including kitchen equipment and upholstery. The client neither has the time nor the desire and the need to visit the building site while his house is under construction. Why should he? He bought a Toyota House or a Sekisui Heim house. The quality control is done by the supplier and can be trusted: if not they would immediately lose the consumer confidence, thus the client, and future clients.

3.3 Research and Development in Japan

Change disturbs the daily routine and that is what every builder can do without. The construction industry in the Netherlands is industries based on traditions (a tradition is a way of working that has always worked) and not keen on innovations. If business goes well there is no need, if business goes down, there is no money for innovation. In Japan on the contrary, if things go wrong, it is concluded that it is time for drastic changes and government as well as industry allocate large budgets to innovative research.

![Fig. 2. NEXT21, Osaka](image)

When in the eighties of the former century the cracks of mass housing and mass consumption of energy in Japan became visible, Osaka Gas Company initiated a large test project, named NEXT21. Besides experiments in the field of energy saving and supply, many more experiments were included, such as roof gardens, consumer ori-
ented building, systems design, rules for dimension and position of building parts to support flexibility during the design process as well as the construction and management phase. The design team, led by prof. Utida, had informed themselves well about the state of the art in America and Europe. In Delft they took knowledge of the latest developments in modular co-ordination, which in turn was Japanized as a super modular co-ordination with an even smaller grain than the Dutch proposals. The 10 – 20 cm tartan grid developed by the SAR in Eindhoven was made visible in the tile patterns of the public spaces. While the building was under construction the Japanese bubble economy burst, which also was the end of such large-scale high profile experiments in housing.

Although the economy in Japan is low and it is quite likely that it will adjust to this level, the mentality to innovate has remained the same, be it at a smaller scale, however, not less interesting. Tokyo has its KSI, Kodan Skeleton Infill project and Nagoya a similar Skeleton Infill Housing project, named Flexus House 22. In stead of a complete super structure such as NEXT21, both projects consist of two a series of bays over two floors, as a cut out of a large housing project. Every bay is finished as a house as an environment for different experiments and tests in the field of flexibility, changeability, organization of ducts and services, new connecting techniques and interfaces and IT applications. In the Nagoya project, every bay is the domain of a commercial supplier, such as Panasonic, Toto and INAX. Again, in this test building different tests are done. The building rests on its foundation though a thin layer of Teflon, thus protecting it form violent horizontal movements caused by earthquakes.

3.4 Leaner than Lean

In factory made houses we recognize the principles of lean production. Sekisui Heim is a manufacturer of dwellings based on a steel frame. Steel profiles are connected using welding robots. The frame then moves through the factory from station to station on a system of computer programmed roller conveyors and turn tables. Toyota House dwellings are also based on a 3D steel frame. Toyota does not have a capital intensive computer directed transportation system in its factory, but a system of small flatbed trolleys that are moved from one station to the other by a man on a mini tractor. Toyota went full circle. The inventors of the Toyota production system appreciate that humans are leaner than machines.
3.5 Product development

Looking at other country, with a different climate and culture we see things that are 'different'. Three examples.

In Japan too, the dweller's idea about the house is a building that has to look like a house, with brick walls and a pitched roof. In order to create the exterior look a brick veneer of ceramic strips is popular. Tostem has developed a system consisting of a ceramic board with horizontal grooves, in which brick strips can be hooked. Other systems make use of metal rails to connect the brick strips on.

The toilet pot in Japan is subject to continuous innovation, not just in terms of shape, but also in terms of functionality, such as a heated seat, shower, built-in ventilation, up to a measuring devices to determine the pH value and saccharimetry of diabetics, whose status need to be checked on a daily basis. Seat heating and shower can also be purchased as a set up seat. For the small-housed Japanese there is also a hand wash basin, integrated in the water container.
Bathing habits in Japan are different from the western world. First the body is cleaned under the shower, and then one takes a hot bath to for relaxation. This has resulted in culture specific bathroom constructions. Prefabricated bathroom cubicles are made of glassfiber reinforced polyester wall ceiling and floor panels that are waterproofed in the corner joints. This in turn is the frame to be finished according to the client’s wishes. A finish is applies, this could be ceramic tiles and equipment and appliances are installed.

4. Conclusion

The housing industry in the Netherlands is gradually shifting from a supply to a demand market. In order to satisfy the customer’s needs, we have to shift from mass
housing to mass customisation. This paper linked the principles of Open building to Lean Construction in order to give the focus to look at some developments in Japan.

Old ways and habits do deal with clients need to be replaced by ways of communication that put the client in the first place. If we do not serve the clients satisfactory, they will vote with their feet and will drive non-communicative parties out of business. Although selling techniques can attract the client, after sales service is just as important for the reputation of the supplier. It is the supplier's lifeline to keep informed about client's demands. In the Netherlands, the way the price is made and the quality secured is diffuse. This is amplified by the tendering system, which lack the incentives to strive for a better quality. The client is responsible for the quality control, which is time consuming and nerve-wracking. This makes it understandable why existing houses are so popular: At least you know what you get. The traditional housing industry is not lean, because in order to make profit, it optimizes on its internal processes. If Concept House does not focus on the user, it will never get a market value, it will remain a designer toy only.

Comparing the Japanese and the Netherlands innovation process, we can notice differences. In the Netherlands there are large government funded innovation programmes such as IFD, dividing large budgets over many projects. In addition there are high energy, nevertheless modest initiatives such as Concept House. In Japan, large innovation subsidies are concentrated in large projects, including sub projects that are conducted and evaluated coherently.

Understanding the larger national and international context of mass customization of housing helps the Concept House project to select from a broad range of sources to tap and to focus on results people are waiting for. We can learn from Japan, how they became inspired, how they focus their energy on what is needed in order to make it happen.

References


The frame concept providing freedom for dwelling

Bernard Leupen
Associate Professor, (Architecture, Dwelling), Faculty of Architecture, Delft University of Technology, Netherlands.
b.a.j.leupen@bk.tudelft.nl

Abstract

Houses have an average life span of about a hundred years, whereas households and habitats can change radically and repeatedly during that time. Taking not the changeable but the permanent as a departure-point opens up new perspectives. The permanent, or durable component of the house, constitutes the frame within which change can take place. This frame defines the space for change. The frame concept can also be used as a design tool to design houses able to withstand the time factor.

Added to the existential, temporal and industrial aspects of dwelling, the 'dwelling of the future' is bound to be characterized by a number of dualities. Dwelling has been marked since its inception by a duality between localization and nomadism. A second duality of housing is the contrast between the ancient idea of the dwelling as place of security, as opposed to our need to relate to the outside world. A third duality that crops up in connection with dwelling is that between modernity and tradition, between technological innovation and attachment to the past. Finally Three types (Cocoon, Service core and Envelope) are described as a different answer to the dualities of modern dwelling.

Keywords: Frame, Dwelling, Cocoon, Service core, Dualities of dwelling
1. Introduction

Houses have an average life span of about a hundred years\(^1\), whereas households and habitats can change radically and repeatedly during that time. Consequently house designers are faced with the task of giving form to a shelter for dwelling for a period during which the composition of the household and the associated spatial rituals will go through major changes.

Flexibility and changeability are key words in the approach of design for the unpredictable. When the architects of the modern movement at the beginning of the 20e century where facing the problems of mass housing flexible floorplan became a topic. Specially the concept of the minimal dwelling and efficient use of the space generated new solutions with sliding doors and folding beds providing the change from day to night floorplans. In the Netherlands Mart Stam and Johannes van den Broek designed houses (see fig. 2) based on these ideas\(^2\). Beside of the day and night floorplan some architects at that time developed concepts for the free plan like the so cold plan-libre of Le Corbusier and later the support concept of Habraken.

![Daytime and nighttime floorplan](image)

**Fig. 2. Floorplan housing designed by J. van den Broek**

Taking not the changeable but the permanent as a departure-point opens up new perspectives. The permanent, or durable component of the house, constitutes the frame within which change can take place. This frame defines the space for change.

The frame itself is specific and has qualities that determine the architecture for a long period of time. The space inside the frame is general, its use unspecified; this space I have called generic space.

The notion of frame is inspired by the book Earth Moves by the French architect and philosopher Bernard Cache (Cache 1995). One of Cache's assertions is that architec-
ture is the art of the frame. He distinguishes three functions that the frame performs: it separates, selects and rarefies. In the present study I propose that the frame has a fourth function: it frees. Take, for example, the loadbearing column. It relieves the wall from acting in a loadbearing capacity, it frees the wall. The non-loadbearing wall can then be moved freely. A notion essential to the frame's functioning is that of disconnection. The column can free the wall by virtue of the fact that wall and column are not inextricably linked, in other words they can be disconnected.

Of what the frame might consist of? A building can be separated up into a number of layers that together define the building as a whole. Accordingly, the building can be regarded as a composition assembled from these layers. Each layer is distinguished from the others by the special role it fulfils. In the frame concept it is assumed that every layer may in principle serve as a frame. Basing my information on texts by Laugier (1977 (1753)), Semper (1851), Loos (1962 (1898)), Duffy (1990) and Brand (1994), I have made a distinction between the following five layers:

Main loadbearing structure (columns, beams, loadbearing walls, trusses and structural floors). The loadbearing structure transmits the loads to the ground.

Skin (facade, base and roof). The skin separates inside and outside and at the same time represents the building externally.

Scenery (cladding, internal doors and walls, finish of floors, walls and ceilings). This scenery defines the space including its visual and tactile qualities.

Servant elements (pipes and cables, appliances and special amenities). The servant elements regulate the supply and discharge of water, energy and air and also include the appliances necessary to them and the spaces primed to accept these.

Access (stairs, corridors, lifts, galleries). This layer takes care of the accessibility of the spaces and/or the individual homes.

2. The frame as a design tool

The frame theory and the accompanying concepts provide a sound tool with which to analyse the nature and functioning of projects dealing with flexibility or changeability. The question now is whether the frame concept can yield more than just a tool for analysing existing projects. Armed with the instruments of analysis I developed, I have analysed a series of cases, but the question is, can the frame concept be deployed as a design tool to design houses able to withstand the time factor.

The question of how houses will have to be designed and built in the future is apparently simply an engineering problem: study what technological developments may mean for housing in the future, investigate the consequences of technological development for the production of dwellings, and hey presto... the programme for designing and producing the houses of the future!

This approach bypasses a number of fundamental questions concerning dwelling. In the first place, there is the question of the essence of dwelling. The act of dwelling is more than the consumption of a place of shelter. In Heidegger's view, it is an existential matter. People have to learn to dwell, and they can do so by relating to what Heidegger called Das Geviert (the Fourfold): earth, sky, mortals and gods. In this sense dwelling and 'being' are closely bound up with one another. To Heidegger, the
A dwelling is an outcome of the act of dwelling. The Dutch architect Habraken expressed his understanding of this notion as follows:

'A dwelling is not a thing that can be designed or made. A dwelling is a result. The result of a housing process. The last act this process is that of the occupant who goes to live there. The act of living there is the only one act which makes a dwelling of something (a space, a building, a hole in the ground)' (Habraken 1970) p. 3

Secondly, there is the ongoing question of the meaning of dwelling in a rapidly changing society. Dwelling has changed its meaning considerably over the last few decades. This is the result of a number of social developments, such as increasing prosperity, individualization and – in Western Europe – the immigration of non-Western ethnic groups. In this essay, I consider the consequences of these developments for the act of dwelling and for the design of dwellings.

Besides changes in the meaning of dwelling, the time dimension plays a part in thinking about it. The rapid changes affecting the practice of dwelling make it increasingly unpredictable. Building, by contrast, is an activity that fixes its materials in place for the longer term. The average life span of a house in the Netherlands is about 100 years, whereas the average period of occupancy of a house is only about seven years. This means that the house has to 'perform' on an ever changing housing market several times during its life cycle. It must also be noted that we add only a fraction to the existing housing stock annually (from 60,000 to 100,000 dwellings as against a total of nearly 7 million dwellings), so the housing market operates for the greatest part with the existing housing stock. Much of that stock was moreover built in the period between the 1950s and 1970s.

The building of a house is to a certain extent a localized in space. It is partly because of this that the industrial production of dwellings has never really taken flight, despite many efforts to achieve it. Tempting analogies with the vehicle industry fall flat: a car is not required to last a hundred years, it is not place-bound, it does not have to meet the highest insulation standards and – not insignificantly – a car has a narrowly defined function.

It has become widely accepted during the last fifty years that it is in practice possible to manufacture parts of a house by industrial methods – for example built-in kitchens, plumbing, staircases, floors, roofs, doors and walls. The building industry nonetheless lags behind. Every component, whether mass-produced or not, must necessarily be delivered to a fixed place, the building site, at a certain moment. It is not only this localized character of building, but also the fact that our conservative taste in matters of dwelling hampers the acceptance of new materials, and thus impedes rapid industrialization of the building industry4.[note 2]

3. Dualities

Added to the existential, temporal and industrial aspects of dwelling, the 'dwelling of the future' [nieuwe voetnoot / literatuurreferentie: Het Nieuwe Bewonen] is bound to be characterized by a number of dualities. Dwelling has been marked since its inception by a duality between localization and nomadism, between the genius loci and placelessness. The Norwegian architect Norbert Schultz proposed that the act of dwelling is not really fulfilled until it takes place in harmony with its surroundings. A precondition for this is that the practice of dwelling, and thus the house, responds to the genius loci, the spirit of the place (Norberg-Schultz 1985). Opposing this is the
compulsion that people feel to move; the nomad in all of us creates that inner agitation that Western man has channelled into the annual trek to the sun. Modernity and the accompanying alienation force us more and more often into nomadism. Many city-dwellers are continually in transit from place to place, from home to home, from city to city. Not only obligations like work, contacts and career-building, but also the mere challenge, the craving for new experience, sets us on the road. The Italian philosopher Massimo Cacciari explains this placelessness as follows:

'The twentieth century is the century in which a radical uprooting takes place, the century in which every place loses its specificness and is reduced to an equivalent alternative in a cycle of universal circulation and interchange.'

A second duality of housing is the contrast between the ancient idea of the dwelling as place of security, as opposed to our need to relate to the outside world. Modernity fans the embers in both directions. On the one hand, we want a window on the world, so as to miss nothing of the dynamic happening outside. But at the same time we want security: we want to be able to retreat from that outside world. We wish to be free to shut ourselves off, to slow down and fulfil our self.

Security implies a space that allows us to turn inwards. Benjamin speaks here of an etui, a soft-lined 'compass-case' that shows the imprint of the dweller (Benjamin 1982) p. 291-292. Our need to relate to the outside world, to communicate and to experience what is going on around us, leads to an open, transparent architecture with large areas of glass, such as the modern movement so enthusiastically championed.

A third duality that crops up in connection with dwelling is that between modernity and tradition, between technological innovation and attachment to the past. We collect the latest technologies in and around the house: we want the latest kitchen fittings in the latest materials, we want ADSL, we want computer-controlled central heating, the latest DVD player with Dolby surround sound and a flat screen TV, all in the latest styling. When it comes to the design of the container of all these things, the house, we tend to be more conservative however. We want warm materials (wood) and traditional materials such as brick and marble; we want net curtains, we want panelling and (if necessary false) beams in the ceiling; we want a rustic-style kitchen, but executed in the latest materials such as stainless steel or Corian.

There is also a fourth duality to be discerned in dwelling, and that is the duality between the functional and the functionally indeterminate. We wish on the one hand for everything in the home to be exactly and efficiently planned: minimum walking distances, perfectly designed bathroom fittings, no risk of banging your head anywhere and nowhere being forced to bend down unnecessarily. The Functionalists believed that the pinnacle of modernity was to design a house according to ergonomic analysis à la Taylor. Life in a modern, efficient home was specified in dimensions and figures. It is meanwhile clear that not every aspect of dwelling is measurable. It is primarily those matters that make the act of dwelling a form of living -- the spatial rituals -- that do not fit into the ergonomic analyses. Besides, dwelling does not remain forever unchanging. Residential patterns, spatial rituals and domestic styles go in and out of fashion faster than we can build houses. The time factor gives the duality between the functionally exact and the functionally indeterminate a further dimension: the indeterminate becomes the unpredictable.
4. Two domains

To make the 'dwelling of the future' possible, that which makes the act of dwelling possible – the physical dwelling – may be regarded as consisting of two parts, two worlds or 'domains'. Each domain has its own properties and character. The two domains are a response to the dualities: in brief, another abstract idea for that which must make dwelling possible – the house – or that which is the result of the practice of dwelling – the dwelling. But what does this mean for the practices of dwelling and building? At first sight the concept of the support and the infill as put forward by Habraken (Habraken 1961) and the SAR would seem to be a practical interpretation (SAR 1972). With this concept, the building of structures that make dwelling possible (for the main part supporting structures with access and connections to public utilities) are seen as a social task, while the infill of these structures can take place in a manner oriented towards the individual or the client. In Habraken's view, this is where the act of dwelling takes place.

But it is questionable whether this is the correct or sole answer to the new practice of dwelling and its dualities. The diversity of the dualities makes that look unlikely. So must a separate solution be sought for each duality? Does there exist one type for the pair genius loci versus non-place, another for security versus openness, another for new techniques versus tradition and yet another for functionality versus the indeterminacy of dwelling? In that case there would be, for each duality, a market with a specific type of aspirant dweller. But the structure of the housing market is not as simple as that. It is better to seek spatial models which somehow incorporate several of these dualities at the same time.

Thousands of models could be constructed – fortunately – but to give an idea, a sketch, of an approach I here describe three distinct types. Each of these types defines the borders of the field of discussion in a particular way. This is made possible by an approach in which the house is divided into a more or less permanent part – The frame - and an impermanent part.

5. Three examples

Each of the types described below represents a different answer to the dualities of modern dwelling. Each type has a differently adjusted balance between permanence and change, between security and openness, between frame and generic space and between tradition and modernity. This balance determines the character of the type. The result is a typology of different houses. Different houses can thus be based on the same concept, the concept of the dualities.

5.1. First example: Service core. Freedom around the necessary

In the first type, the two domains consist of one domain with all those matters that can be set down in exact dimensions and numbers, and another domain that can be laid out according to taste. The first domain contains those matters that satisfy the laws of ergonomics, such as kitchens and bathrooms. The second is the area where living takes place – living in the sense of realization of the self (see fig. 3). The house is here a product of the practice of dwelling. This type is inspired by the distinction drawn by Louis Kahn between 'served' and 'servant' spaces.

From the viewpoint of the duality between modernity and tradition, the service core is the place for technological innovation: the latest technical equipment, shining
stainless-steel kitchens etc. In the second domain, the occupant is free to surround himself with every desired comfort. This type is also legible from the viewpoint of the duality between the functionally defined and functionally indeterminate things such as spatial rituals.

The service core can be designed exactly on the basis of use, of an analysis of the actions that take place in the bathroom and kitchen. The core exudes efficiency. The core consists of a durable accommodation in which the only the most essential servant elements are provided, such as a heating system, a toilet, bath, shower, washbasin etc., and possibly a kitchen worktop. This core forms the permanent part of the house and should be designed to last for generations.

In contrast to the service core, the house has spaces where the dimensions, shape and materials are determined by the rituals that take place there, by the atmosphere and mood desired for the room. Designing the details of this part of the house are a part of the practice of dwelling. A new occupant will wish to put a personal stamp primarily on this part of the house. The simple, light structural components of which this house is built make it easy for the occupant to modify it.

Fig. 3. Service core. Freedom around the necessary

5.2. Second example: Cocoon + transparent

The second type of house consists primarily of an enclosed part, a cocoon in which the occupant feels secure, can retreat from the world and enjoy the hearth (see fig. 4). This part of the house stands for permanence, for 'eternal values'. Alongside, behind or around this part, there is the possibility to create a temporary or permanent extensions using the latest techniques and materials; an extension that satisfies the wish for transparency, an outlook on the world and making contact with the ever-changing contemporary scene.

The hearth has long symbolized the centre of the house and is the hub of many traditions. Around the cocoon, the occupier is free to determine the form of the house and hence of living. In the process of dwelling, the occupant will choose to actualize his wishes as new spaces for working, sleeping, eating and living. The cocoon part containing the hearth is built of durable materials and presents a 'stony' face to the outside. The cocoon part is built by a construction company on the basis of a sup-
plied design, whereas the occupant can build the transparent part or have it fabricated according to personal taste. The latter is the part of the house that grows along with the occupant. The house effectively records a history of the act of dwelling around the one fixed point, the hearth.

![Fig. 4. Cocoon + transparent](image)

### 5.3. Third example: Envelope around a free interior

A third type is based on the duality between an inward-looking practice of dwelling and life in the metropolis — similar to the contrast in the villa designs of Adolf Loos'. It consists of an envelope — a roof with walls — under which there is a two-storey high, freely disposable space. The envelope provides a comfortable indoor climate and a sense of shelter, and leaves the occupant free to surround himself with everything he needs for his self-development. The walls and the roof are equipped with the latest technologies and allow the dweller the maximum freedom to express his or her personality (see fig. 5).

The envelope (or the skin, in architectural terms) is constructed on the basis of a self-supporting framework. The outside of the framework is fitted with cladding which is chosen by the client and is appropriate to the location. The cladding provides the necessary insulation and has adjustable transparent parts that provide the desired level of daylight and views of the outside. A layer on the inside of the framework functions as a heating system. This can be minimal, thanks to the high grade of insulation and a well-adjusted energy equilibrium. The self-supporting framework of the skin has dimensions and a construction that leave space to accommodate the
various building service systems and equipment\textsuperscript{5}. The internal layout of the space is formed by an autonomous structure built up from easily exchangeable elements.

Fig. 5. Envelope around a free interior

Conclusion

Within the practice of designing and building houses, these concepts represent a revolution in thinking about what a dwelling is. A house is no longer a single object designed by a single architect and built by a single contractor. The house will always somehow be a configuration of different 'domains'. Each domain will have a distinct manner of design and production. In the third case above, for example, a design could be made for the outer skin which includes accommodating space for all the technical systems that control the indoor climate. It will be possible to produce the resulting envelope by serial or non-serial methods\textsuperscript{9}. The required technical systems and equipment for conditioning the space can then be fitted into the accommodating spaces designed for them.

The interior work, the layout or 'set design' of the interior space, could be part of an integral design, but in general it will follow a process of its own. I picture a development partway between industrially fabricated components and do-it-yourself activities, such as already common for kitchen furnishing.

Although the envelope presents a permanent character towards the outside, its interior work will change frequently in the course of time in accordance with the needs and wishes of the occupants. Changes to the interior are no longer classed as building activities. Instead they form as much a part of living in a house as things like changing the curtains or fitting a new kitchen unit do today. This conception has consequences for building regulations, building site supervision and insurance\textsuperscript{10}. Building and dwelling are no longer regarded as two distinct processes but as forming part of a continuum.

Since the housing market is substantially supply-dominated, the concept described here and its detailed execution will also have to be applied to the existing housing stock. This necessitates a different interpretation of the existing housing stock. Many
housing types in the existing stock may be read in terms of the concept described above. The ‘domains’ described above are similarly already distinguishable in many existing houses.

The types defined here illustrate a mental approach – a concept, as we call it in the architectural world. The types are not meant as designs that can be built as they are, but as mental models that may set designers and other people involved in the design of houses thinking. Perhaps they will elicit new ideas about what has to be permanent – The frame - and what kind of freedom could provide this frame. The modern house must respond to this duality, or indeed express it. So the house becomes the frame within which the act of dwelling, of living, plays out. The dwelling is the outcome of occupation of the frame; the dwelling is the house (the frame) plus that which the dweller adds by dwelling in the house.

4 Note that a house is cheaper per square metre than a car. What is more, the average lifespan of a house is ten times that of a car.
5 Drawings by Jante Leupen
6 The French philosopher Luce Irigaray writes about this as follows:

‘Fonder un foyer, c’est fonder une nouvelle demeure, une nouvelle maison, en particulier autour d’un centre, souvent assimilé au feu domestique: lieu qui sert à se nourrir, à se chauffer, à se réunir. Ainsi, dans la Grèce antique, la mère portait une flamme de son propre foyer pour allumer le feu domestique de sa fille nouvellement mariée.’

(‘Founding a hearth is founding a new home, a new house, in particular around a centre, often assimilated to the domestic hearth: that place which serves for nourishment, heating and meeting. Thus in Ancient Greece, a mother would bring a flame from her own hearth to light the domestic fire of her newly-wed daughter.’) Irigaray, L. (1999). Entre Orient et Occident. De la singularité à la communauté. Paris, Bernard Grasset. P. 139-140

7 Hilde Heynen describes this as follows. ‘Modern human beings function in a complex society with a variety of social settings and possibilities; they are therefore obliged to resort to a cover that permits them to separate their own personality from the outward forms that it adopts. Only in this way can one respond to all these disparate demands without continually being obliged to expose one’s whole personality. This ‘cover’ for the personality consists in the first instance of the clothes one wears and in the second place of the architecture of one’s dwelling... The home must be shielded from the outside world. The surroundings of the metropolis, ...’ Heynen, H. (1999). Architecture and Modernity. A Critique, MIT, p. 98

8 Cf. the 19 inch racks used for professional audio, video and other electronic equipment.

9 Given the present state of advancement of computer aided manufacturing (CAM), we can imagine numerous variants being fabricated in serial fashion using a single basic design. The products could vary per client and location without additional cost.

10 A dichotomy of the house could lead to a corresponding dichotomy in the law. For example, the building regulations and aesthetic bylaws could apply solely to the frame, i.e. the permanent part of the house, while everything that takes place in the generic space is a matter for the insurers.
A European Concept House
Designed by Europeans for Europeans

Richard Horden¹, Wieland Schmidt²

¹ Univ. Prof., Institute for Architecture and Product Design, Technical University Munich, Germany.
sekr.horden@lrz.tu-muenchen.de

² Assistant, Institute for Architecture and Product Design, Technical University Munich, Germany.
wieland.schmidt@lrz.tu-muenchen.de

Abstract
If I were to write my own brief for a Concept House it would start with the word European as an icon for the things that drive my work, my life and my leisure. Europe today may not be an economic miracle at this moment, but it is still the greatest cultural powerhouse, with the best educational institutions and architecture in the world the best coffee, fashion, music, opera, the best car and aircraft manufacturers, a collaborative space industry, the best football and sports venues the best art and art galleries the widest range of geography, climatic and cultural experiences and a population of 500 million! As a starter for a project like 'concept house' where could be better.

The issues that drive thoughts for a European Concept House come from many years of study into the area of prefabrication, habitation and transportation.

Inspirational:
The concept house must exude European style, a BMW, Mercedes, Mini or smart or Swiss espresso machine must look good next to it. It must be politically correct and energy minimal in use, it must have a full life cycle consideration in its design.

Adaptable:
The concept house must appeal to a wide client; from young people, students to elderly couples from newly weds to families. It must be liked or talked about, by children and adults, it must be capable of expansion and contraction. It must adapt to different cultural styles and locations, to flat sites and hillsides to urban context, suburban and rural.

Affordable:
The Concept House must have a basic cost footprint which gives it and its parent organisation a firm economic grounding to encourage investment and shareholding in a long term future.

Compact:
The Concept House must be appropriately compact in scale, to the precise point, neither indulgent or too small, nor excessive in material use. At the same moment it must have a sense of generosity of space, light, view and detail.

Keywords: Inspirational, Adaptable, Affordable, Compact, European
1. Introduction

1.1. A European Concept House Designed by Europeans for Europeans

It would not only be too simple but also ineffective to initiate a discussion about a Grand Project such as this by falling into technical jargon. This is a project to be designed by Europeans for Europeans, just as our student micro compact home was designed with students for students. The European Concept House is for the people who will use it not for the machines that will fashion it. The concept requires a clarity, there are many ways to build but only a simple message can inspire; a fine goal would be to produce an ‘icon design’ but the subject is for people and European people vary, a lot! How to produce a simple elegant project that can fulfil dreams and practical realities for even a small proportion of the 500 million who live and will live in Europe in the future? If Europe is about contrast and differences, America is about sameness. How does our project become inclusive of our differences and at the same time be practical in production... an impossibility? There is just one thing that can unify: beauty. Beauty in form and performance.

1.2. A European Concept House man and nature

Our, or maybe I should say my Europe, is the home of Ferrari, Airbus, Opera and haute cuisine it is the home of the tiny espresso, the smart, Concorde and Champagne, Italian fashion and Swiss graphics, Lakes and the Alps, Venice, Zurich, Paris, London and Amsterdam, Giacometti and Le Corbusier, Wimbledon, and the Monaco Grand Prix... we can only truly begin a great project like this with no less an ambition than to be in balance with our incredible range of traditions and beauty of landscape and culture. The European Concept House is for man and for nature.

1.3. A European Concept House transportation and habitation

Much of the work and development of factory produced architecture, in both our Institute at the Technical University in Munich and the London office, is driven by combining ideas from transport, nature and architecture for example the Ski Haus combines elements from the helicopter and the traditional Zermatt Alpine hut. The micro compact home from the airline interior, Japanese teahouse, and Marijke de Goey... the ‘Skydeck House’ from boat deck, yacht construction and the traditional terraced house and European lakesides.

To develop a convincing factory production home today, it is essential to include and integrate traditional ideas with modern factory production methods from our traditions in marine, aviation, electronics and auto industries.

A recent visit with our students to the BMW supplier factory of Drexelmaier near Munich demonstrated precision robotic handling techniques, combined with the use of the natural material sisal as panels for the door interiors for the X5, 7 and 3 series. Fast, advanced production and handling of natural materials...the European Concept House will be made of different materials at different times, of wood and fibre soaked in natural resins but the digital components, design, production and marketing skills must be tailored to the dreams and aspirations of people, young and old and new Europeans...like the Airbus A380 it must be a spirit lifting exercise in teamwork and product design, inspirational and a practical aid to sustainable life for future generations of Europeans.
Transport has always informed architecture...for example the upturned hull of an early Viking boat informs the construction of the early English church roof...it is no different today... influences of car production and aviation on our lives over the past one hundred years has made profound changes to our way of life and our way of building... a drive for lighter construction and more precise dimensional control. Increased engine reliability, communication and navigational precision has speeded the development of compact design and digitally controlled analogue systems, GPS etc. this in turn is reinforcing the home as an information and communication centre becoming both a work place as well as a home, remote control of home soon to become a regular part of our lives.

Work in the home cleaning, washing and food preparation offer a wide scope for the designers of robotic and automated systems in future...the European Concept House like the European car, aircraft or elegant Italian or German modular kitchen must offer truly convincing advantages in choice of finishes, low energy performance, technology and adaptability to its wide range customer base.

Parallels with transportation and aviation are not only practical they are spiritual and poetic as in aviation 'if it looks right it is right'. I believe that both the practical and spiritual basis for a grand project such as this is simple beauty in form, fun and function!

Fig. 1. Espresso

Fig. 2. Airbus A380
Developed by Richard Horden and two of his students in Philadelphia in 1992, the SkiHaus has now been in use for ten years.

In April 2004, Richard Horden and I visited Switzerland to install it in its new location near the Matterhorn. The SkiHaus was to stand on the bare ice. From earlier operations, we knew that the most exposed positions are best suited for such a purpose.

We waited at an altitude of 3,900 m for the helicopter that was to fly in the Ski Haus from Zermatt. The 450-kilogram structure consists of a load-bearing framework of yacht-mast sections. Three adjustable feet allow it to be erected on almost any terrain. With an ice pick, we hacked three pockets for the feet in the glacier and then filled the holes with loose ice. Suddenly, however, the weather changed and a snowstorm came on.

The thermal insulation cushions, borrowed from aircraft technology, had been installed in 1994 and had become damaged through the heavy use of the structure. We therefore tested a composite material specially developed for the Ski Haus— a vacuum insulation panel 20 mm thick with a 3 mm waterproof lamination adhesively fixed on in the inside face. During the night of the snowstorm, this mechanical protective layer ensured a comfortable atmosphere—but in only one small part of the house; for the surface of the cabin has so many different areas that every vacuum insulation panel would need to be individually manufactured, the cost of which would be prohibitive. We did find a simple but effective way of insulating the perspex single glazing, though. A top-hung sheet of perforated aluminium fixed on the outside at a distance of 2 cm from the window prevents excessive heating when exposed to direct sunlight. The wind that blows at night drives snow between the aluminium sheet and the perspex pane, providing an effective form of insulation. Although the layer of
snow darkens the interior, it keeps it warm. Inside the Ski Haus, there is space for four people to sleep on tubular aluminium bunks. Two comfortable seats at the front also afford a panoramic view of the natural surroundings when the weather is fine.

Richard Horden and I turned on the 12-volt lighting – a simple reading lamp borrowed from automobile construction – and prepared our evening meal. In testing the capacity of the battery, we found that the wind rotors of the generator allow the production of energy even in a snowstorm, whereas the small photovoltaic plant on the roof functions only when the sun is shining. Today, the Ski Haus is used as emergency accommodation or as a mobile station for high-altitude research.

Fig. 4. The all-aluminium frame at Sparcrafts Lymington (UK) factory.

Fig. 5. The Ski Haus flying in from Zermatt.
3. The Skydeck Project

Architects: Richard Horden, Thomas Höger, Sarah Kirby, Oliver Stirling and Michael Wigginton.

An informal design group was formed in 1990 with Ove Arup & Partners, Jack Zunz and Jourdan Engineering to examine a high quality, factory built house system. Jourdan Engineering had supplied a lot of the prefabricated toilet modules for the rush of city building in the late 1980s and had extensive experience in shipping and handling high quality prefinished units.

![Image 1](image1.jpg)

Fig. 6. The Sydeck House is informed by marine techniques

The design became focused around the typical urban row house which lends itself well to prebuilding. Opposite our design office in Golden Square, there was a relatively small building site which required four hundred truck deliveries to build a five-storey building over eighteen months. The development of light factory-built systems could make an enormous difference to this pollution and disruption of city life.

![Image 2](image2.jpg)

Fig. 7. Simple steel frame and currently available technology and materials enable the Skydeck project to be realised relatively quickly.
Benefits would also be felt in the construction industry as skilled subcontractors could be based in-factory, in out-of-city areas, with in-house leisure facilities, swimming pools, restaurants, shops, and stores.

The Skydeck Project is informed by the yacht and car production industry. It would be delivered and marketed like a Beneteau yacht or an Audi car, with emphasis on the quality of the product, the wide choice of colours, surfaces, finishes and fittings. It would have computer-controlled energy systems. Skydeck extensions would be delivered to order and fixed while owners are on holiday. Use of views and roof space is implicit in the name 'Skydeck'.

Fig. 8. The 1:50 scale 'waterfront' model. The modular units and Skydeck can be realised using different configurations and internal volumes.
4. Peak_Lab Research Station

Architectural Department of the HTA Lucerne
Prof. Ulrich Pfammatter

Tutors: Christian Fierz, Mathias Frey, Armando Meletta, Urs Rieder

Department for Architecture and Product Development,
University of Technology, Munich
Prof. Richard Horden
Tutors: Lydia Haack, Walter Klasz

Structural engineers: Joseph Schwartz, HTA Lucerne

Located on the Klein Matterhorn, Peak_Lab is a visionary concept for an Alpine research and testing station in a lightweight form of construction. It is designed to accommodate three people, who can live and work in the laboratory for three weeks at a time. At an altitude of nearly 4,000 m, the extreme climatic conditions, with wind speeds up to 260 km/h, restrict building activities to roughly 50 days a year. Prefabrication is essential, therefore.
The station can be installed in different locations, but since it has to be transported by helicopter, the dimensions and weight may not exceed certain limits. The structure is therefore divided into five modules, with a vertical ladder linking the individual spatial units. At the top is the ventilation plant. Below this, the second module – reached via a gangway – contains the entrance/wind lobby, a cloakroom space and sanitary facilities. The mechanical services are housed in a compact container in the third module, where there is also a cooking and dining area. The actual laboratory is in the fourth module, with divisible sliding, folding tables that can be used as laptop working areas or as a couch for high-altitude medical investigations. The lowest module serves as a sleeping compartment.

Fig. 10. Interiors

Peak_Lab is self-sufficient in terms of energy supply and waste disposal. Electricity is generated by photovoltaic cells over the entire surface facing the sun. Fresh air is sucked in via wings on the entrance module and fed into the ventilation plant above. The air then flows down through the ventilation space behind the facade, where it is heated by the aluminium cladding. A reheating apparatus finally warms the air to the desired internal temperature. Drinking water is provided by melted snow; and waste water is reprocessed. The lab is held in position by only three anchor fixings concreted into the rock. The entire load-bearing structure, consisting of the triangular vertical lattice-truss spine, the gangway and compression struts, arrives by helicopter. It is fixed to the anchor points and stayed with cables. The modules are then flown in individually and hung on to the spine.
5. Micro Compact Home \textit{m-ch}

Client: Studentenwerk München, Dipl. Kfm. Dieter Maßberg  
Sponsor: O2 (Germany) GmbH & Co. OHG, Timo Schneckenburger (Vice President Marketing)  
Architects: Horden, Cherry, Lee Architects, London; Lydia Haack + John Höpfner Architekten, München  
Conception: Univ. Prof. Richard Horden, Technische Universität München, Lehrstuhl für Gebäudelehre und Produktentwicklung  
Copyright design micro compact home: Prof. Richard Horden, London  
Patents: European patent cover  
Production: Micro Compact Home Production GmbH, Tel.: +43 (0)77 24619720, www.microcompacthome.at, rg@microcompacthome.at  
Contact: Micro Compact Home Ltd. London, Tel.: -44 (0)20 74954119, www.microcompacthome.com, info@microcompacthome.com

The micro compact home is a mobile, modular dwelling capable of being adapted to various sites. It has been designed in collaboration between the student welfare organisation Studentenwerk München, Horden Cherry Lee Architects and Haack Hoepfner Architekten, developing from the 'i-home' student project at Richard Horden's Institute for Architecture and Product Design at TU Munich.

The work has been sponsored by telecommunications group O2, and a prototype will be built early in 2005 with a village of ten 2.6 metre cube units completed later in the year north of Munich. This will be used as a case study for micro-compact living, social interaction and energy-saving performance.

![Fig. 11. Prototype](image)

The extent to which individual expression is achieved and the resulting nature of the communal spaces between the units are important to the success of the project. An additional unit is to be used as a 'micro-communal space'.

70
The micro compact home may be arranged as a single unit raised above the ground on a light aluminium frame and placed in a garden for private use. Its compact dimensions make it easily integrated with shrubs and trees. Micro compact homes may be grouped in horizontal or vertical arrangements in compact clusters, or form larger villages for social or student accommodation or for short stay business or leisure use.

Four functioning spaces define the interior of the m-ch: sleeping, working, cooking, and hygiene. The double bed folds upwards when not in use. A dining and working table provides space for up to five people; it may be slid aside for storage access or stowed away completely in the storage zone. The kitchen bar has twin levels to serve both the table and bed spaces. The entrance lobby also functions as a bathroom.

Informed by aviation and automotive design, and manufactured at the micro compact home production centre, the m-ch can be delivered throughout Europe with project individual graphics and interior finishes. The micro compact home is a development of the i-home, a 2.6m cube designed by Prof. Richard Horden and his team of students and assistants at the technical university in Munich.
6. Tree Village

Architect: Richard Horden

Designed primarily for student housing the 15m high tree village is planned with the minimum 12m square footprint to fit a mature landscape with tall trees. The structure is made up of a cluster of small steel vertical columns or reeds making minimal foundation disturbance to tree roots and vegetation.

The heart of the project is an open core space containing the central lift shaft and stairway with the vertical services 'reeds' in turn surrounded by the thirty micro compact homes. These are grouped around the core to provide maximum transparency and openness for the penetration of branches.

The roof of one unit provides a platform for landscape in the foreground of a higher micro compact home.

This advanced technology project is a proposal for a University location in Central Europe. Similar to the O2 Village project funding would be from a corporate organization with land provided by the state.

Fig. 14. Tree Village Project by Richard Horden, Micro Compact Home Ltd.
7. Golden Cube

This project is inspired and informed by the richness of Venetian architecture and the traditional Venetian boats such as the wooden Sandolo and more recent Riva launch and water taxi.

The Golden Cube is a richly textured gold anodised aluminium clad micro compact home with floats arranged under the boat pontoons on either side of the 2.6m cube. When the cube is delivered to Maestre from the production centre in Austria it is towed to a temporary location, by special permit, in the lagoon. The vertical piles on either side are then lowered into the lagoon ground to stabilise the cube and platforms. Access to the tiny two person cube is only by boat so when the micro mini bar is adequately stocked with prosecco the cube makes a perfect retreat for the newly wed couple!

The small amount of energy required to power the electrical systems in the micro compact home is provided by photovoltaic panels arranged on the canopy above the entrance. Modest cooling uses lagoon water circulated by solar pump. Waste is stored and removed by boat to avoid pollution of the lagoon.

Fig. 15. Golden Cube by Richard Horden, Micro Compact Home Ltd.
8. Reed Huis

The Reed Huis is one of a series of projects designed by the Amsterdam based artist Marijke de Goey and architect Richard Horden from London.

The project pioneers new ideas in combining art and architecture, the ephemeral and practical, mass and lightness, density and openness.

This personal retreat is specifically designed for a reed and water landscape. Marijkes characteristically Dutch steel and aluminium mast sculptures provide a strong visibility and three point support for the small micro-compact home designed by Richard Horden and his team in Munich where he is professor of architecture and product design at the technical university.

The house contains double bed, work point and dinner for five, kitchen, toilet, shower and storage in an easily transported 2.6m cube. Solar, wind and hydrogen fuel cells may be added to provide pollution free and independent energy sources.

A second sculptural frame supports a small yacht or dinghy out of the water, sheltered by a light canopy.

The reed huis personal retreat can be located unobtrusively on a canal side, island or private land waterside, its small dimension enables the minimum of intrusion into nature.

The compact dimension of the reed huis is designed to compliment the scale and form of a reed bed landscape and provide a base for short stay overs for summer sailing or winter skating, a guest house, or weekend nature retreat, at a relatively affordable cost.
9. Living in the city

1999, Project, London
Architects: Horden, Cherry, Lee Architects, London
Stefano Angaroni, Stephen Cherry, Adrian Fowler, Davis Franklin, Richard Horden, Billie Lee, Peter Ludwig, Kwamina Monney, Jurgen Schubert, Andreas Vogler, Danielle Williams, Peter Zimmer

Also known as the 'City Arcade', this is a concept for an urban living, working and leisure building prototype. It was designed for an international competition. Entries were exhibited at London's Design Museum in 2000.

Horden Cherry Lee's entry was developed in partnership with Swiss and German designers and prefabrication contractors OFRA, and all entries addressed a major disused site just to the east of the City of London but could be applied elsewhere.

Shown here is one element of the concept. It can be repeated in modules to fill larger sites and aims to establish a pre-fabricated, low-cost, low-energy, high-density urban building form capable of accommodating the widest possible range of uses.

Its form derives from European-scale streets and arcades. Its layered elevations refer to the playfulness of the famous Eames House (1945-1949) in Santa Monica, California.

Fig. 17. Informed by the beautiful Eames House in Pacific Palisades, Los Angeles. 'City Arcade' is a giant filter for urban habitation, communication and transportation.
The City Arcade would provide both community and privacy, separated from busy streets and rail lines, with apartments orientated to catch the sun. Lifts, bridges and stairs would animate the enclosed public space and connect public circulation to generous private balconies extending living and private space. Trees and balcony planting would soften the arcades and courtyards.

A 'hobby level' is located at rooftop level, while the grid frame accommodates services units, photovoltaic cells, gardens, allotments, workshops, party and weekend events, guest rooms or studios – all with great city views.

Cars could be stacked vertically in the scheme, powered by solar cells enclosed in the stacking system, so the ground level space could be maximised for pedestrians, who would be encouraged to use bicycles and public transport.

City Arcade was developed with construction industry contributors to use fully prefabricated residential units based on a module of 5 metres width – the typical width of a London terraced house. Modules would be delivered within six months to any European city from a central European factory.
The Universal House
An Outlook to Space-Age Housing

Andreas Vogler
andreas@architectureandvision.com

Abstract

Sending Humans to long-duration space missions like Mars, is imposing radical challenges
to the way we look at the human habitat. We have to build a complete machine for living,
which will support all hard and soft requirements of human life under extreme conditions
with minimum space and minimum energy use. This requires light-weight mobile structures,
autonomous and interactive environmental systems. Similar trends can be found in terres­
trial architecture, where the house eventually could become, through technology, a more
active part of the planetary ecosystem.

Keywords: Space Habitats, Extreme Environment, Mobile Architecture, Autonomous Sys­
tems, Psychology

1. Introduction

"If our designs for private houses are to be correct, we must at the outset take note
of the countries and climates in which they are built."

Vitruvius, de architectura 6.1.1, ca 27 bc

"The Earth is the cradle of humanity, but one can not live in a cradle forever!"

Konstantin E. Tsiolkovsky, 1911

The space-age has made fundamental impacts on our understanding and perception
of our home planet Earth. The first images from the Earth seen from space, espe­
cially as the “blue marble” taken by the 1968 circumlunar Apollo 8 team, showed us
the preciousness of this blue planet with its thin atmosphere in the vast dark vacuum
of space (figure 1). These images helped a growing understanding of the limitation
of resources and the understanding of the Earth as a living system. This was first
postulated by James Lovelock in the early 1970s in his ‘Gaia’-Hypothesis.¹ The inter­
esting point in this hypothesis is, that favourable conditions like average tempera­
tures of 15°C and atmospheric oxygen content of about 20%, were not provided for
life to happen, but actually established by life and maintained by it. Without life it is
assumed the Earth would have an average temperature of about 240-340°C and an
atmosphere consisting of 98% carbon dioxide [1]. The architect has been aware of
the influence of the environment on the architecture as much as the profession has
learned by failures in the early industrial cities in the 19th century as well as in the

¹ The Gaia-Hypothesis was named after the Greek goddess of the Earth. As much as it was
praised by the esoteric movement at the time, it was rejected by the sciences, whether geophysics, chemistry, geology, or biology, which believed they said all that there was to say about
the Earth. Dubbed under 'Earth System Sciences' and 'Astrobiology', today there is a clearer
scientific understanding of the interaction of life and its environment.
social housing programs of the 1960s, where the influence of the architecture on the environment has been ignored. We know today, also by satellite data, that the tremendous growth of our cities and the sub-urban sprawl is counteracting on our environment dramatically. It was Buckminster Fuller [2] who pointed out that the Earth should in fact be regarded as a spaceship. (Figure 1 and 2).

![Image 1](image1.jpg)  ![Image 2](image2.jpg)

Fig. 1. The Earth is our home. A wonderful large scale macro architecture with dynamic systems. Images taken from the Galileo Mission in 1991. Credit: NASA

Fig. 2. The astronaut suit is representing a micro architecture, allowing the human being to live 8 hours in free space. Credit: NASA

What we face, when designing a space habitat is, that we have to build a ship, which handles speeds of 30'000 km/h and more, provides all life-support functions like fresh air, drinking water, food, environmental control and deals with our metabolic off-products like the system Earth does in a recycling way. Further, the longer the mission the greater the need to compensate for the lack of our social life and psychological experience. Leaving the gravity of Earth demands great energy and requires minimal volume, minimal mass and minimal energy systems for spacecrafts.

Thus, a space habitat can be characterized as

- Mobile
- Autonomous
- Interactive

Although there are still many unknowns on how the human being will adapt to long-duration spaceflight and how the design of space habitats will evolve, it is claimed here, that the space habitat is the prototype of an 'universal home'. It has to be able to offer in one way or another all basic functions, which we usually get for free on our home planet. It thus forms an 'archetype' of architecture\(^2\). The world is incorporated into the spacecraft.

There are actually clear trends in terrestrial architecture, which point into the same direction of mobile, autonomous and interactive homes. There is a tendency, that houses will incorporate all systems to be independent from the environment. The

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\(^2\) Archetype is not understood temporally of what has been first, but as the general concept of a minimal optimized system for the human being to 'live' (not just survive) in the most extreme environment of space. Today's spaceships are still far from that optimum.
viewpoint from space architecture should help to clarify some aspects of the human habitat in its most extreme condition and hopefully help start a new practical and theoretical discussion about the human being and the self-made environment in the space-age. Thus, outlining an outlook for future concept houses, not deriving from the past, but heading into the future.

2. The Space Habitat

Space Habitats are the most challenging of extreme environment habitats. As new human missions to the Moon and eventually to Mars in the time-frame of the next 20-30 years are realistically discussed by the Space Agencies, we just start to realize, what challenge this is for the human being. And although architecture is one of the oldest professions, we do know little about the implications and countermeasures of sending a crew of six in a 8m diameter tin can for two years to Mars, as current mission plans are proposing [3]. Three main characteristics of future space habitats will be 1.) Mobility, 2.) Autonomy and 3.) Interactivity³. These will eventually impact our understanding of the terrestrial habitat, which is in fact also a 'space habitat', just on a planet with more favorable conditions, than the ones around us.

2.1 Mobility

Space habitats are vehicles, even if their final specification is a surface habitat. They need to leave the gravity field of Earth travel through space and land on another planet. The mobility has major implications and restrictions on its construction, dimensions and mass. The space shuttle (figure 3) can fly 24'400 kg to Low Earth Orbit with a fairing of 4.7 m diameter and a length of 18.6 m. The whole International Space Station (figure 4) is build up on these launch dimensions and mass. The average speed of the station is 28'000 km/h. To fly one kilogram of mass into Low Earth Orbit costs currently USD 20'000. If you price the 3.5 kg of potable water, the 0.62 kg of solid food and the 0.84 kg of oxygen needed per day per astronaut [4], you start to realize how valuable resources in space are. When you have to bring everything from 'home', you start to look at your home differently.

³ Further important characteristics, which are not included for this essay are radiation protection and pressure vessel structures.
For surface habitats, these restrictions lead to discussions and research of how to use in-situ resources (ISRU) to produce energy or to build domes and shelters against radiation with regolith, how the local material on a celestial body is called.

2.2 Autonomy

Up to these days spaceflight is still dependent on resupplies from Earth. The International Space Station ISS is resupplied, by the Automatic Transfer Vehicle ATV, which brings consumables like water, food and oxygen and is filled up with waste before burning during re-entry into Earth’s atmosphere. To go beyond the Earth’s orbit, autonomous closed-loop systems will be necessary. There are several research programs moving in this direction. Space simulations are planned or have been conducted like the chamber experiment at NASA-JSC (figure 5). The primary goal of the Lunar-Mars Life Support Test Project (LMLSTP), conducted from 1995 through 1997 at the NASA Johnson Space Center, was to test an integrated, closed-loop system that employed biological and physicochemical techniques for water recycling, waste processing, and air revitalization for human habitation. As an analogue environment for long-duration missions, the conditions of isolation and confinement enabled studies of human factors, medical sciences (both physiology and psychology), and crew training. The results of these studies provide a wealth of important data not just for Space Shuttle and ISS missions into space, also other missions in extreme environments here on Earth. The longest simulation was done by a crew of 4 for 90 days, using wheat to re-vitalize the air and a bioreactor for the water recycling process, which used microbes to clean-up the water. An incinerator was used in the solid waste processing system to turn crew fecal matter into ash and gaseous carbon dioxide products for reuse by the wheat [5].

These systems will have to become light-weight with a minimum power usage in future. The astronaut of the future will likely be a ‘bionaut’ as well, living in symbiosis with controlled plant and bacteria systems on smallest space (figure 6).

Fig. 5. In this 6m diameter vacuum chamber, NASA tested autonomous life support systems for up to 90 days. Credit: NASA

Fig. 6. Plants provide oxygen, clean water and provide food. They are also supporting the crew psychology. They are an important factor in spaceflight. Credit: NASA
2.3 Interactivity

The astronaut will be forced to live in a closed interactivity with the spacecraft. Technical systems will monitor the environment, but will also need to be maintained by the astronaut (figure 7). Housekeeping is a major task in small spaces, even more so in weightlessness. More than that on a long-duration spaceflight the sensory deprivation will be a major psychological problem. Once the terrestrial orbit is left, there will be no day and night cycles, no clouds moving, just black space with a bright sun and distance stars and planets. The systems and interior design of a space habitat will have to provide countermeasures for that [6]. They will have to allow the astronaut to reconfigure the interior as well as to provide active sensory stimulation by the use of light, acoustics, odours and materials (Figure 8). Real-time communication with Earth will impossible, when a signal from Mars to Earth takes 20 minutes one way. A personal conversation robot may also become an important device for expression problems outside the crew community. The most extreme environment may actually be our inner self.

Fig. 7. The Zvezda Module of the International Space Station is the main Habitation Module at the moment. In the foreground you see the dining table. Credit: NASA

Fig. 8 Mars Habitat Crew Quarter design concept by TU Munich. The Crew Quarter contains a interchangeable modular storage system. The light can be adjusted by computer in colour, intensity and distribution. Credit: TU Munich

3. The Universal House

"Who said pleasure is not useful?"

Charles Eames

In the 18th century Abbé Laugier derived the 'Urhütte' (Primitive Hut) from a natural timber construction (figure 9). The looks of the building were dominated by its structure. Le Corbusier separated construction and appearance of the house in his five points of architecture establishing the Maison Domino as the 'primitive hut'. The looks of the building were dominated by its function. Today, without any deeper theoretical discussion nor vision the looks sometimes seem to be fairly independent from anything, maybe from the last update of the Nurbs modeling software. Space Habitats have to develop their own aesthetics under the laws of nature and limited resources (figure 19). They are highly optimized complex structures, they form the 'primitive hut' of the space-age, a universal house, which works on Earth as well as
on any other celestial body. A next step to the concept house of the future may be a more research based optimization of the production, the advanced environmental requirements of the house and the interior needs of the inhabitant. Thus a modern house could evolve, leaving behind the iconic discussion, and rather develop like a modern industrial product, where design is more than styling, but systems integration.

If we just consider the three characteristics mentioned for space habitats, it shows us astonishingly known concepts, but also provides an outlook towards space-age housing, which can be defined as the scientific understanding of architecture as the technical interface between the human being and its environment. The architectural understanding of technology does include aesthetics and pleasure as functional needs of the human being.

3.1 Mobility

Mobility in architecture is not a new concept. Nomadic tents are likely to be the oldest and lightest structures ever built and date back to 25'000 years. But also the most impressive transport logistics started with architecture. The Cheops pyramid built 2530 BC, consists of about 2.3 million stones, 2.5 tonnes each and transported from quarries around 1000 km distant. Nevertheless, the reality on some modern building sites, does not seem much more advanced since then and the level of prefabrication is still relatively low. The requirement of mobility is driving construction to lighter, compact and modular structures and is an important element of the industrial production of houses. Mobility comes together with prefabrication. An important advocate of mobile building is Richard Horden [7][8], who continues to blur the boundary between vehicle and architecture and thus working on the aesthetic and technical language of these small-scale structures (figure 11). Extreme environment building like in the mountains also requires different solutions. The short available building time during summer and the transport by helicopter require a high degree of prefab-
rication and a modular design, which is taking into account weight limits and flight dynamics (figure 12)

Fig. 11. Skihaus by Richard Horden. A small light-weight mountain hut, which can be transported by helicopter.

Fig. 12 Design for a high altitude weather station in the Swiss Alps. Credit: Andreas Vogler

3.2 Autonomy

The traditional farmhouse has been fairly autonomous, based on a in-situ resource utilization, providing food from crops and animals and fire wood from the forest (figure 13). With the growth of the cities and the building up of modern infrastructure this concept has been lost. Most buildings are fully dependant on supply of water, electricity and heating energy. With the oil crisis in the 1970s a better insulation of houses and the use of solar energy started to reduce the energy need of houses. Steady improvements in materials and building technologies led to the passive house standard, making active heating redundant. Although the zero energy house is not economic yet, the industry developed a drive and the market of houses is a potential mass market. The Fraunhofer Institute recently predicted a substantially growing market on passive houses in the next 10 to 15 years [9]. There is a clear trend of houses becoming self-sufficient again (figure 14).

Fig. 13. Traditional farm-house in the Austrian Alps. Credit: Petra Gruber.

Fig. 14 Competition design for a autonomous mountain hut. Credit: Architecture and Vision.
3.2.1 One Step Beyond: Houses are improving the environment

The reduction of the energy use of building and their self-sufficiency is an honorable objective, but regarding the expected development of the world's climate, this may not be enough. Buildings of the future should not only visually improve the environment, but also clean the air, collect water and produce energy and fresh vegetable for our daily needs. Now this may sound romantic, but is actually challenging our continuing romantic understanding of nature. The NASA BioHome project employed inhouse plants for wastewater treatment, harvesting drinking water, crop growth and air purification [10]. A more compact vertical arrangement of plants, supported by robots and LED lights can become the 'green lung' of a house. The house would become the technological equivalent of the tree, actively cleaning the air around it.

3.2.2 Another Step Beyond: Water for the World

As we get excited by technological possibilities, we shall not forget that according to UN reports 1.1 billion people don't have direct access to drinking water (figure 15) and 2.4 billion don't have access to basic sanitation. Developing countries often do not have the means for extensive infrastructure. Mobile and low energy water recovery systems can help to improve the situation and maybe allow a technology jump as it happened with the mobile phone. The insufficient infrastructure in landlines was suddenly redundant in many developing countries by the growing market of the mobile phone. Analog to the mobile phone market the large housing market of the wealthy countries can help to make a cheap mass product in the future out of a now expensive technology (figure 16).

Fig. 15. According to UN about 50% of the world's drinking water is carried on women's heads.

Fig. 16. Mobile Eco Units powered by solar energy can provide safe sanitation. Credit: Architecture and Vision

3.1 Interactivity

In the last century all formerly public events have also been privatized and integrated into the home. The radio brought the concert hall, the TV the Cinema, the washing machine the former washing house etc. This century will start with the integration of data systems and the interactivity of the house and the user.

Further technology movements are directed towards the networked 'Smart Home' and household robots, making the home a fully interactive 'machine for living', as it has been postulated as early as in the 1920s by Le Corbusier and others. But as alienation and social isolation of the individual is increasing in the modern mass soci-
ety, these ‘toys’ become more than just an electronic servant. They become objects of affection. The Sony QRI0 and the Honda Asimo robot (figure 17) recognize your face, can dance and walk and offer social skills. ‘Cocooning’ is a recent and growing trend for making the home the main center of one’s private life. The home has to increasingly serve for the ‘grounding’ of one’s senses. A growing in-house wellness market is reflecting this. ‘Home’ is the cradle of one’s privacy and psychological health. Like in a space habitat, the terrestrial home will increasingly offer countermeasure against exhaustion, boredom and loneliness.

Fig. 17. The Honda Asimo robot shows social skills and interacts with the people around. Credit: Honda

3. Results and Discussion

The comparison of the space habitat and the existing trends in terrestrial architecture show that the Universal House is more and more developing towards a fully technically controlled environment, a machine for living. What is a requirement for a space habitat – incorporating everything needed inside – becomes an evolutionary trend in the terrestrial home. This is going that far, that not only the physical comfort of the inhabitant will be maintained, but also the psychological comfort. Now this is happening at a time, where machines become invisible and technology gets smaller and smaller, but also friendlier and less frightening than it has been before. Embedded systems will allow the architect to work in a new dimension with space, light and material. The requirement for mobility in aerospace creates lightest structures and new materials, which provide highly compact spaces for living. Buildings have been becoming lighter and lighter through history. Modern buildings employ light-weight materials, saving transport mass and grey energy. It is a clear technology development: lighter, smaller more efficient, or ‘Touch the Earth lightly’.

Autonomous building systems are needed for spaceflight and face an increasing market potential in the housing segment. First buildings are built using vacuum toilets, a system known from aerospace and trains. These use five times less water and are gravity independent, providing more flexibility in design. These systems will also create a new relation to resources and nature. Inhouse gardens complement their technical and psychological functionality. Buildings in future will be able to not just to reduce their own energy and consumables need, but actively clean the environment and provide energy.
An interactive environment in the space habitat will allow the environment to adapt to the activities of the astronauts, but also to countermeasure against sensory deprivation. The smart house development is exploring similar steps. The research from spaceflight will also affect the leisure industry and vice versa. There is a need for people for 'power relaxation', 'resetting' after a working day. Much of the leisure time of modern people is used by inefficient relaxation. The future house will be able to react to the moods of the inhabitant and to be pro-active about it.

Nevertheless, the construction industry is lacking a lot of innovation found in other industries. Whereas the Aerospace industry is leading in research, it is especially the automotive industry, which is leading in production. A similar approach to houses can only be found in Japan. In USA and Europe the standard house factory is basically a building site put under an industrial shed, with builders crawling on their knees over timber structure, cutting insulation material and hammering nails into panels. But neither in Japan nor anywhere else the prefabrication of houses is reaching a substantially higher market share than 15% in average. The majority of houses are built by local companies with 2-10 employees. There are different reasons for this, which need to be understood. Although production is a major key to lower costs and rise quality, mass production is not the only key as well as low costs is not the only market. In the US, where manufactured housing mostly supplied the lower end of the market, the industry had a severe drop with the current housing boom, where the market shifted to the mid-range and luxury segment. Different in Japan, where industrial housing industries where able to maintain their market share throughout the sharp recession on the market. Japanese industrial manufacturers where always focusing on the mid-range and high-end market, offering quality and life-time warranty for their products. The evolution of the new home will neither happen by marketing studies, production technologies nor design alone, it only can happen by a interaction of all elements of this complex system. And, it only will happen, if we keep on challenging our preconceptions of the home.

Fig. 19. Mercury House II is a concept house by Architecture and Vision introducing mobility, pro-active environmental systems and interactive, robot-supported environments. Credit: Architecture and Vision.
3. Conclusion

Long-duration Human Spaceflight requires a full symbiosis of the crew and its spaceship, which will have to provide a ‘whole world’ for them. This ‘micro world’ development can similarly be detected in the terrestrial house, where increasing building technology and smart systems make the house and its inhabitants more and more independent. As architects we need to keep up with these developments and help shape them to increase the quality of our lives and our environment. Concept houses play a crucial role in this development, since these technologies are initially expensive and we need to use them to understand them. But also the concept of ‘home’ needs to be questioned rigorously. If we observe the reality of house building as it happens everyday, it seems, that we have never been as far away from a truly modern architecture as today. But maybe the house of the future is not evolving from the mass market, but rather from a niche market, where it develops its identity and is ready, when the generic perception of the house is changing as the way we view our world is continuously changing.

3. References


Towards a Floating Concept House?

Ties Rijcken¹, Mick Eekhout²

¹ PhD researcher Concept House, Faculty of Architecture, Delft University of Technology, The Netherlands.
   t.rijcken@bk.tudelft.nl

² Professor of Product Development, Faculty of Architecture, Delft University of Technology, The Netherlands.
   m.eekhout@octatube.nl

Abstract

The Dutch water management system requires more buffer capacity to deal with the increasing amount of water intruding the Netherlands from various directions. At the same time Holland suffers from a lack of space to meet demands such as housing. The government supports multiple use of space. For example, floating neighbourhoods combine water storage with dwellings. Innovation is required on various levels: a) creating new water landscapes, b) developing new urban planning concepts, c) inventing new civil engineering constructions, d) designing new building types and e) developing new building products. A floating modular foundation element, made of a concrete space frame around a Styrofoam core, is such a product. The Concept House team focuses on customized high quality housing with flexible functions and more control during the whole life cycle. The studies on floating dwellings can contribute to the Concept House goals, and vice versa, for example using themes as flexibility and on site assembly.

Keywords: Modular Housing, Floating Foundation, Houseboats, Water Management

1. Introduction: “H₂Ope for the Low Lands”

In 2002 manufacturer of floating houses ABC Arkenbouw approached the faculty of Industrial Design Engineering in Delft. The Netherlands are changing, more water is coming in and we will have to start building floating neighbourhoods. Products will have to be developed to make these neighbourhoods safe, affordable, sustainable and attractive. Ties Rijcken took on this problem statement during his internship at ABC Arkenbouw. In 2003 he completed his graduation project “Neerlands H₂Oop”, freely translated towards a global level as “H₂Ope for the Low Lands”. It got awarded with grade 10. Two national student awards followed in 2004 and 2005.

The investigation of “living on water” has been done by intermitted research and design. Two concepts have been developed. The “H₂Orizon floaters” were designed to level tilted floating houses due to an uneven mass distribution. The market of 10,000 floating houses in the Netherlands is currently being served and hopes are high for future houseboat neighbourhoods. Secondly a modular floating foundation system for buildings, infrastructure and greenery is still being developed. Ongoing interdisciplinary research is linking various design levels and disciplines to global and political climate change [1].

The development of floating houses can support research conducted in the Concept House group, and the other way around. For example, floating houses offer flexible Concept Houses an even flexible foundation. Vice versa: industrially produced build-
ing systems are more easily assembled on a floating hull than traditional houses. This article will conclude with an investigation of mutual benefits and related questions that are still to be answered.

Water Threat in The Netherlands

Sources:
KNMI 2001
Geofoon 2004
Delft U.T. 2004
Wolters-Noordhoff 1995

Predictions are averages between minimum and maximum values for the year 2100, settling peat for 2050

© ABC Arkenbouw Urk

Fig. 1. Water threats from various directions (graphics ABC Arkenbouw)
2. Water Abundance in Delta Areas

According to the Dutch "weather forecast for the 21st century" we are going to see more rainfall and related river water influx, with higher peaks of intensity [2]. The ocean levels are rising. Furthermore, the Dutch Delta Area, located at the end of the river Rhine, suffers from settling peat and the intrusion of salt water due to seawater pressure in the so-called "polders" – areas of reclaimed land that often lie more than 3 meters below sea level.

In order to keep the water out, we will have to increase our overall pumping capacity, heighten our dikes and increase our buffer capacity. The latter can be done by creating storage areas where the water level is able to rise and fall. These areas will look like lakes or clusters of lakes and ponds.

Buffering will have to take place on various scale levels. The government is developing guidelines to enforce new neighbourhoods to buffer peaks in rainwater supply (the "watertoets"). Houses should also be protected from river floodings. In the past decade numerous aldermen of cities have granted building permissions to developers to build neighbourhoods in the "winterpolders", areas that historically would flood in springtime after heavy rainfall. The threat of the sea is the highest scale level. The disaster scenario of the Netherlands is that the Maeslantkering, a storm surge barrier at the end of the Rhine, will have to be shut due to a stormy North Sea and at the same time the river water supply is peaking. The Dutch will then have two options. Either wait for the water to choose its own course or sacrifice designated areas in order to save cities like Arnhem or Rotterdam. To determine certain emergency flooding areas in order to create radical storage capacity, is topic of an enduring debate.

3. Conflicting Claims

The economically powerful western part of the Netherlands suffers from a lack of space. The Dutch Ministry of Housing and Environment has listed required surface areas for various spatial claims in the near future, such as nature preservation, recreation, water storage, commercial activities and housing. The researchers and planners conclude there is not enough space available to supply all demands for space. There is currently a housing shortage in the Netherlands. The Dutch secretary of Housing commits to adding another 445,000 dwellings to the existing housing stock within the next five years, resulting in a shortage of only 1.5% [3]. This analysis has led the government to support multiple use of space. For example, planners are united in the
Habiforum Platform to investigate this task and to run pilot projects. At the faculty of Civil Engineering in Delft, Professor Jan Vambersky studies technical solutions to combine various spatial claims in urban environments.

It will be difficult to, for example, combine nature preservation with offices. But water storage can be combined with a claim like recreation or, if engineered and designed properly, with houses or glasshouse horticulture. This requires a building type that allows the water level underneath or around it to fluctuate. An obvious way to realize this is by buoyancy. Floating offices, greenhouses and dwellings can contribute both to a water management system that adapts to global climate change and to economic development.

4. The Flood

Over the last decade we have seen a rising concern for the Dutch water storage problem among water managers, scientists, planners, and designers. Among hydrologists it is more or less common sense that the Netherlands will be inhabitable within a hundred years. Landscape designers H+N+S (of which Dirk Sijmons has been appointed as the national advisor for the State Architect Mels Crouwel) claim to be on a “crusade” to warn the Dutch authorities for the nearing disaster. Adriaan Geuze (design office West 8), curator of the second Dutch Architecture Biennale, chose this years theme of the international event to be “the Flood”. Floating constructions and floating dwellings are among the presented concepts.

Dutch Universities picked up the subject. The faculties of Architecture at the Technical Universities of Eindhoven and Delft have organized several masters assignments related to waterproof building and planning. Students have graduated on concepts of floating buildings.

In the current building practice a number of projects have been carried out. The most famous is “Marina Oolder Huuske”, an orthogonal cluster of recreational houseboats in a branch of the river Maas in Limburg. This project even appeared in a stamp series on “legendary Dutch water works”. Many contractors and developers conduct research and build pilot projects. Dura Vermeer is highly active in promoting their vision on “waterproof building”. Their dwellings along the river Maas near Maasbommel got overwhelming international attention. Dura Vermeer also works on floating greenhouses in very low parts of the Netherlands. At the moment a 900 square meter pilot project is floating in Naaldwijk. ABC Arkenbouw has realized a project of twenty clustered floating houses in Kortenhoef (het Gooi) and built relatively large floating offices and a restaurant.

Fig. 2. 2nd International Architecture Biennale Rotterdam
5. Houseboats

The Dutch have a long history on single free-floating dwellings: houseboats. Fishermen have always lived on barges or boats. After the Second World War, rail- and road transportation partly replaced the large fleet of Dutch river vessels going up and down the Rhine and Maas. Many people started living on the surplus of these vessels. The authorities granted them locations to be based until there were about 10,000 legal mooring spaces, scattered all over Holland but mostly in and around Amsterdam. Over the last three decades, each year between one and two hundred houseboats were replaced by new houses on floating concrete hulls. Houseboat lovers are now often wealthy people who enjoy the presence of the water and often desirable locations along rivers and canals. They don't want to live in vessels with a gypsy-like touch but in modern houses offering all the comfort that is nowadays possible.
Various manufacturers can build high quality floating houses. ABC Arkenbouw is the second biggest of the about twelve "ark builders" in the Netherlands. Monitoring the water storage development, the company built a factory to produce floating houses in modular series. In this new plant, single floating houses could still be built to meet individual needs, but it also has the capacity to manufacture over twelve similar houseboats a week. This supplies the rising demand for houseboat projects. As in IJburg (Amsterdam) and Leidscherijn (Utrecht), part of the housing zone will be a floating neighbourhood, providing local water storage and more dwelling diversity. These projects are unique in combining already known concepts. The infrastructure is similar to a marina, using existing dock construction systems. The floating houses are houseboats on concrete hulls. In Marlies' Rohmer's design for Waterbuurt West (IJburg, Amsterdam) some two and three houseboats are connected to each other [4]. Yet, the floating body for the houses has the same size of the building on top; there is no floating garden or pavement rigidly connected to the house.
As an Industrial Design Engineering student and ABC Arkenbouw R&D manager, Ties Rijcken has developed various innovations to support houseboats and floating communities. Experts were consulted at the faculties of Maritime Engineering, Architecture and Civil Engineering. One product has made it to market: the "H₂Orizon levelling floaters". A roto-moulded L-shaped floater can be easily placed under a houseboat to lift it with a force of 300 liters. Between one and ten floaters can bring a houseboat to a horizontal level, depending on the initial inclination. Over one hundred floaters have now been produced, competing with existing levelling systems in price and durability.
A floating neighbourhood does not only contribute to the water management problems, but it also is an attractive alternative for inhabitants. What makes water so special? Among many reasons: the tranquility, the view, the water birds and an often acclaimed sensation of freedom. The experience of living on the water is described as “pacifying” or “balancing for the hasty urban professional”.

An important finding was a specific design solution for a floating island, namely *maximum length sides*. People most often prefer water, land and greenery all combined. This can be found along shorelines. Unlike an artificial sand island, a floating island can be shaped in any way. One side, then, can be created such that everyone on the island is able to enjoy the dynamic interaction between the island and the surrounding water.

Fig. 10. Two H$_2$Orizon floaters – right: the lifting principle (© ABC Arkenbouw)

### 6. Modular Floating Foundation

On the current market there is no affordable and sustainable system to support houses, infrastructure and greenery on the same floating platform. Existing floating foundations are steel hulls, enforced concrete hollow boxes, and Styrofoam blocks that are stacked and protected by a concrete shell. ABC Arkenbouw has developed an ultra light modular floating foundation concept for various applications. Steel fiber concrete is poured around a core of specially moulded Styrofoam layers, creating a streamlined “space frame”. The Styrofoam guarantees durable buoyancy - the concrete frame provides many anchor points to which building skeletons can be mounted.

The Styrofoam core provides four advantages: 1) it creates an unsinkable system, 2) it isolates, 3) cables and tubes can be placed in special gutters, and 4) it serves as a lost inner mould when pouring the concrete, enabling the modular system to be engineered as a light-weight construction: minimizing material, improving handling and saving energy [5].

The honeycomb structure provides an alternative grid, inviting alternative architecture. The hexagonal sides of a platform create a floating body with less straight sides that resemble natural shores. Nevertheless, an orthogonal grid using a multiple of thirty centimeters obviously adapts more easily to existing building technology. The development of the concept has been such that switching to an orthogonal system changes the geometry but the underlying concepts will be maintained.
Fig. 11. The floating foundation module has been designed to support constructions, infrastructure and greenery (drawing by Ties Rijcken)

Fig. 12. The floating foundation module consists of a concrete spaceframe around a Styrofoam core (renderings Ties Rijcken/Ruben Arbib)
7. Lightweight Engineering

As mentioned, the Styrofoam core consists of various parts produced in a complex three dimensional mould. This allows the concrete frame to be poured in a relatively free form, provided no traditional steel enforcement is needed. The newly developed BSI B200 steel fiber enforced concrete meets this requirement due to special chemical and geometrical design of the cement, pebbles and steel fiber. Ongoing research on the composite materials and its applications is conducted by Professor Joost Wallraven at the faculty of Civil Engineering, Delft University of Technology.

A second round in technical development of the space frame design has aimed to get more advantages out of the unique combination of complexly shaped Styrofoam and the intrinsically enforced concrete. Border conditions were the draft of the Styrofoam moulds, the planar outer mould and the 35 mm minimum width of the concrete. The "bucket" in the centre of the structure can be poured, using an additional steel core. Also, a specific shape of one of the Styrofoam parts enables the concrete to flow around a Styrofoam core. This creates a tubular structure, reducing the weight with 20%. Other measures can be taken to find the slimmest construction, such as the use of ribs and fillets. This should follow from a finite element analysis, similar to how plastic moulded products are weight-optimised.

In product innovation four highly intermingled paths have to be managed: legal protection, marketing, finance and technology. A patent can form a strong base on which to build further development. Marketing effort is needed to attract finance. Finance is needed to further bring the idea to clients in the market. Clients want affirmations on guaranty and price, which can be estimated by further technological research.

A patent is pending, commercial progress is made by a high level of media attention and technologically further steps will be taken by masters student Maarten Kuyper at the faculty of Civil Engineering. He will study the following questions for his graduation project. 1) how strong are the various forces acting on a floating body, 2) is the current geometry able to withstand those forces, 3) what alternative connection possibilities are possible to create large foundations and 4) which adaptations, coming forth from the first three questions, will have to be made to the current design.

![Fig. 13. The use of Styrofoam and fibre-enforced concrete allows for a complex 3D lightweight design (rendering Ties Rijcken/Ruben Arbib)](image1)

![Fig. 14. This Styrofoam geometry allows the concrete spaceframe to be partially hollow (renderings Ties Rijcken/Ruben Arbib)](image2)
8. From Kyoto to Delft: Technology Diffusion

The floating foundation module came to life because of process changes that are going on at a higher organizational level. Climate change as addressed in Kyoto provokes us to think in different ways. One of these ways is to allow more storage basins to be present in delta areas, since technically it is possible to live in or on the water. Planning in delta areas needs to be reconsidered. A new element will be added to the range of solutions to specific spatial problems, but this requires altering regulations and financial constructions. This takes research, money, pilot projects, risk, failures, mentality changes, ergo: it will take time. What can be done to enhance this development?

In a market economy, process innovation will lead to product innovation. On the other hand product innovation can inspire process innovation. Urban design Professor Han Meyer formulates four design levels: a) creating new water landscapes, b) develop new urban planning concepts, c) inventing new civil engineering constructions, d) designing new building types [6]. A fifth level can be added: e) the product level - developing standard or modular building elements that can be used in different projects.

Do we need small inspiring pilot projects (levels d) and e)) to put the issue higher on the political agenda, or should heavyweight landscape architects like Dirk Sijmons enforce a national guideline so that “waterproof construction” and supporting products will follow [7]? At least the dialogue should be continued between the various levels. Urban planners will play an important part. They can convince authorities of the new possibilities but limit the financial risks by combining them with existing strategies. On the other hand, they will enforce designers to streamline their ideas towards local circumstances, so that the new waterproof buildings and products they design will indeed contribute to water management and to a socially acceptable environment.

Urban Planners can also work directly together with designers to develop new products for floating neighbourhoods. Eventually, an infrastructure will have to be designed that has equivalent qualities compared to living on land. Roads, parking spaces, bike paths, walkways and their connection to existing networks will have to be investigated. Hygiene, sewage, energy supply and environmental matters can be discussed between planners and designers. The same for social and psychological issues such as pet animals and safety of small children.

These issues also vary over time. In urban planning “blueprint thinking” is over [8]. Designs should be able to adapt to changing and even unforeseen circumstances. Various scenarios, including their uncertainties, will have to be formulated. What will happen when a town is submerged and only part of it is flood-proof? Questions like these will have to be answered by specialists on levels a) and b). The Netherlands will have to be re-organised and water management will be guiding. It is not a matter of luxury but of utter necessity [9].
9. Concept Floating House...

The Concept House team focuses on customized housing concepts. Better quality, flexible functions, more process and product control during the whole life cycle of the home. The ways to achieve these goals are by implementing intelligently produced products, a profound insight in market mechanisms and an effective and inspiring interface between the housing options and the eventual dweller. Within a couple of years a number of prototypes should demonstrate these ideas. The studies on floating dwellings can contribute to the Concept House goals, and vice versa.

A Concept House prototype could be one or more houses on a floating body. It will demonstrate that Concept House offers solutions to different kinds of problems in society in a single product. Furthermore the flexibility that the water offers can be integrated in the Concept House research on adaptability. A floating house even has a flexible foundation. If there will be enough mooring spaces in the Netherlands, a floating foundation can provide a system of free circulation of houses: new, second hand or occasions. If this concept will be properly managed on a high enough scale, consumer needs are met to a high extent.

10. ... or Floating Concept House?

The other way around: industrially produced lightweight housing concepts are ideal for a floating neighbourhood. In general the whole house, including the foundation, can be assembled in a short period of time, changed during its lifetime and dismantled without leaving a trace. The whole system, functioning over the entire lifespan, can be considered in one design (or "open source building system" [10]) and coordinated by one entity. There are also practical benefits of a modular superstructure. For example, a small floating body will never be perfectly horizontal, which traditional builders will not like. If a house is not built but assembled, the inclination of a platform is less of a problem.

![Fig. 15. SuperYacht (left image: courtesy of Tim Saunders, right image: courtesy of Octatube Space Structures)](image)

There is a relation between a floating foundation and the option to have the superstructure not only produced but also assembled in various countries throughout the world. Canada manufactures log houses that are shipped across the Pacific Ocean and assembled and purchased in Japan. A fleet of floating houses could be towed.
Professor Mick Eekhout is involved in the preparation phase (design & build) to realize a 170 meter long five-star hotel in the shape of a super yacht. The building process can be compared to line assembly, such as the fitting out of the 'VOC' ships in Amsterdam in the 17th century, to floating tomatoes in the 20th century Westland and with the production floating scheme of ABC Arkenbouw. The hull including the upper skeleton structure of beams will be produced in China and will be towed to Dubai. In Dubai the fireproof floors and walls will be installed. An army of over 100 Indian carpenters will fit out the interior of the 3200 luxury rooms. At the same time the envelope cladding consisting of 3D-formed aluminium and GRP (glass fiber reinforced polyester) components and 2.5D and 3D formed glass components will be installed as a watertight envelope. After that the floating building (no motor, not designed to marine level) will be brought into a 200 meter long floating dock and towed to London, where it will be released and moored in the center of one of the West-Indies docks around Canary Wharf. The production scheme shows that marine transport has been able to convince large scale builders to look on a larger scale than the production plant only.

![Fig. 16. A floating neighbourhood like this will on the short run take too much change and risk, but could technically be possible (rendering Ties Rijcken / Tim van Bentum)](image)

There are problems to be expected and many questions still to be answered. Is too much change not too threatening to policy makers and consumers? How to deal with existing infrastructure? Traditional builders often build houses and infrastructure. When they are building the adjacent infrastructure, they often also have a say in the
development of the neighbourhood as a whole and might insist on traditional houses. Should we include infrastructure in our research?

The Dutch market is relatively small. How do we gain knowledge about other markets, and how can we penetrate them? Flood management is a European and even a global issue, but are other countries interested in floating houses? How can we develop innovations for Concept House and for the "floating future" that provide opportunities for the Dutch Building Export?

Conclusion

There is a flood of interest in floating houses as part of the right way for the Netherlands to react to global climate change. Making this interest concrete requires innovative thinking on a hierarchy of design levels. At the international planning level, water management (including water buffering) should be given high priority. On the eventual product level, concepts as the modular floating foundation system and products like the H2Orizon floaters will then follow. The other way around, they can function as an inspiration for change on higher design levels. The dialogue between the various levels, also in early stages, is crucial. As an intermediate level, urban planning plays an important part.

The research and design activities on floating neighbourhoods can use Concept House themes as flexibility, industrialisation and globalisation. The Concept House Research group can extend its scope and benefit from surfing the water wave.

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The Dutch Housing stock: demands & needs, chances for new housing concepts

Henk Westra
Associate Professor Housing Management,
Department of Real Estate & Housing, Faculty of Architecture, Delft University of Technology, Delft, The Netherlands

Abstract
New concepts in housing are related to the demand in the housing market. Preferences of consumers are changing, according to lifestyles, which demands new approaches to new ensembles (dwelling, environment, services). This change of consumer preferences is manifest in the rental market and the market of home ownership. The question is whether the project developers and the principals in Dutch the housing associations are able to satisfy the demands of their future customers

Keywords: Housing market, demand and supply, lifestyle, housing associations

1. The Dutch Housing stock
Relevant data¹:
The Dutch housing stock consists (01-01-2004) of 6,71 million dwellings. The average occupation rate is 2,4 persons per dwelling. More than 80% of the housing stock is built after WW II, so the housing stock is relatively young. The quality in terms of maintenance is good, only 2 percent is labelled as in "bad condition" (pre-war, private landlords). 71% of the stock is one-family homes, about 29% are apartments. The owners of apartments are, by law, member of an "union of owners"². Home ownership is the tenure form for 54,2 % (3,5 million dwellings). The rental stock is 46,8% (3,2 million dwellings) of the total.

The size of the dwellings is depending on the number of rooms, bedrooms and living room. 28% of the stock is "small": up to 3 rooms, whereas 35% has 5 rooms or more.

2.1. Home owners, tenants and landlords
The Dutch rental stock is relatively big. In an European perspective that is surely so. The government's policy is to increase the home ownership to 65%.
The rental stock can be divided in 3 parts. For about 11% the rental stock is an investment in real estate. Investing parties are private persons (mostly with a small number of dwellings), real estate funds and big investors like pension funds and insurance companies. They own rental dwellings as a part of an investment portfolio.

¹ Ministerie van VROM, Cijfers over Wonen 2004, Den Haag, 2004
² The Dutch civil code (Nieuw Burgerlijk Wetboek) defines what ownership means, what the rights are of tenants or lessees, and what the rights and duties are of the owners in an apartment building.
The main part of the Dutch rental stock, 35%, 2,4 million dwellings, is owned by ca. 520 housing associations ("woningcorporaties"), not-for-profit private organisations, under control of the government by law and other regulations. The not-for-profit status does not mean that there may be no profit, but the spending of the profits and the capital of the housing associations must be and can only be for use in public housing.

The main task of the housing associations is to provide good, suitable and affordable housing for those households who cannot do that by themselves. Most of the housing associations have a history of being a part of emancipator movements, like labour unions, political movements or specific professional groups like teachers, railwaymen, etc. The average portfolio size of the housing association is 3.900 dwellings, but a large number of housing associations are small (20% smaller than 1.000 units). The largest housing association owns more than 70.000 rental units (houses and apartments).

The target groups of inhabitants for the housing associations are therefore the lower income groups in general, and specific household groups like senior citizens, starting households and handicapped people. Especially the lower income groups are the main clients, most of the households who start on the housing market, begin with a rental dwelling of a housing association. The annual rent policy of the government, the communities and the housing associations is directed to a controlled rent increase, just above the inflation level, in line with the growth of the Dutch economy in general. The quality of a dwelling is measured in "quality points"; the total number of quality points relates to a rent maximum. If that level is reached there can be no more increase in the rent level, unless the dwelling is been labelled a "free market dwelling".

Households, who cannot afford the rent of a suitable dwelling, are eligible for rent support. About one third of the clients of the housing associations receive that support for a total of € 1,6 billion. The entrance to the housing market of the housing associations is not easy: the waiting time for a home after subscription in the Randstad is about 3 to 4 years. Housing associations can, in general, not refuse a client who wishes to live in a dwelling of a housing association. Commercial landlords can make a selection of clients (on the basis of income, for instance)

In the homeowner sector by contrast, the market is free: if you have the money, of course. The problem nowadays is that the market prices are high, and the home seeker needs an above average income to get a mortgage. Luckily, the interest rates are low at this moment (5% for a period of 5 years). State support for homeowners is in the form of a fiscal deduction of the total of the paid interest on the mortgage. The total fiscal support for homeowners amounts to € 7 billion.

The yearly production of new homes in the Netherlands amounts to 60 to 65 thousand dwellings, about 70 % in home ownership, mainly produced by project developers and 30% as rental dwellings, mainly by housing associations. In mixed projects the housing associations also build a limited number (ca. 4.000) dwellings for sale.

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3 See for more information: A.Ouwehand, G.van Dalen, Dutch Housing Associations, DUP, Delft, 2002
4 Woningwet and Besluit Beheer Sociale Huursector (BBSH), Ministerie van VROM, Den Haag

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Since 2000 the government pushes for more private principals in the housing market: households who buy a piece of building land and are their own developer, select their own architect and contractor. Until 2000 the annual production consisted for about 14% of this method, mostly in the provinces in the North and East of the country. The government set a target of 30% of the annual production, also in the Randstad. That means that communities have to earmark a bigger part of the available building sites for this purpose.

3. The present Dutch housing market

The present Dutch housing market has big problems. It all starts with the low rate of economic growth, threats of unemployment, a nationwide stop on salary increases, etc. Especially in the market of the more expensive homes, sales have come to a standstill in the existing stock as well as with new constructions. The prices of dwellings are so high that there is no moving from the rental sector (which is relatively cheap in real estate terms) to the homeownership sector. Within the homeownership sector the number of sales is dropping, while in the rental sector most people who would like to move are staying in their rental dwelling. The ultimate victims of this situation are the home seekers who want to enter the housing market.

Until a few years ago the demand for housing was very simply counted in a combination numbers of dwellings and the size in the number of rooms. The Ministry of Housing etc. publishes every 4 years an extensive research of the demands on the housing market5, the latest one in 2002 (WBO 2002). The main conclusions are:

- The real shortage is 166,000 dwellings (in the mean time the estimate is 250,000 dwellings, due to the much lower production of new dwellings);
- The demand in the rental sector has been growing and should now lead to a building program for new dwellings of 50-50% (that was 30% rental, 70% homeownership);
- There are too many small dwellings from the years 1950-1960, and there is a manifest shortage of one-family dwellings in green urban areas;
- There is a shift of consumer preferences to “green living” to villages;
- The demand for suitable dwellings for elderly people will grow enormously. Action should be taken in the existing housing stock and new construction as well; the latter gives the chance for new combinations of housing, care and welfare;
- The annual production of new dwellings should be at least 80,000, and more if there is at the same time a demolition program in the urban renewal areas;
- Etc.

These conclusions should lead to more activities of housing associations in the rental sector in transformation of the existing stock and specific new constructions for elderly households and starters on the housing market. But: being non-profit organisations they may not take an autonomous position in the market of building land, because of high prices and speculation possibilities. Housing associations purchase the

5 Ministerie van VROM, Woningbehoefteonderzoek 2002 (WBO), Den Haag, 2004
see also specific thema studies as: Gescheiden woningmarkten, Den Haag, 2004; Betaalbaarheid van het Wonen, Den Haag, 2004
land they build on mostly from the local communities, for land prices that are suitable for social housing and make an exploitation of the dwellings on the long run possible.

Figure 1. Low-rise housing in Voorhof, Delft

Fig. 2-3. Low-rise housing in the Poptahof (left) and the Wippolder (right) in Delft.
The conclusions of the WBO research for the market of homeowners points towards a reduction of the annual production and, more important, for lower price categories. The purchasing power of many households has decreased in the last years, and the present economic situation does not make the outcast better. Most developers already discovered this in the ongoing production and started to redevelop existing plans with cheaper (and therefore with less quality) and smaller dwellings. Even with such a high shortage of dwellings, the whole chain of involved partners in housing projects and the building industry are not capable of a substantial production increase. That is due to a number of causes:

- not enough ready building sites;
- the procedure for permits is a very long one (and like molasses: very slow);
- the manifest demand for more expensive dwellings has dropped dramatically;
- the production capacity of the building industry is at its maximum.

New approaches are therefore needed!

4. New concepts: what clients are there?

In recent times new methods of marketing have been applied to the housing sector. That is the marketing idea of using *lifestyle* as a pull factor for future clients. Lifestyle is being defined as a consistent set of preferences (attitudes) and behaviour in
the living areas of employment, family, housing, consumption, and leisure. Life
tyles are connected to the combination of choices of places of settlement, travel dis
tances to the work place, services (shops, schools, leisure, etc) in the neighbour-
hood, architecture. Car manufacturers in selecting certain media to reach the target-
group already longer use the concept of lifestyle: the advertising strategy for Volvo
or Saab is different than for KIA. In the Netherlands several marketing agencies have
developed sets of lifestyles for the housing market.

The step from lifestyle advertising for consumer goods to the housing market, is not
yet common, but is already also used for “branding” certain living areas. The “brand”
of a neighbourhood should attract certain lifestyles and avert other lifestyle groups.
The social cohesion in such neighbourhoods should improve. In new housing projects
the selective marketing of lifestyle concepts (type of dwelling, architecture, environ-
ment, services, etc.) would create a stable community, and therefore value creating
in the long run.

The concept of lifestyle in housing is relatively new. Research shows a higher level
of satisfaction with the choices the household made, but it does not explain all the
choices. The tension in the housing market, especially in the rental sector as shown
before, could lead to a selection process by home seekers for the best available
dwelling and not for the “dream house”.

The selection process of households for a new home consists of many elements, but
on the basis of lifestyle research, it is certain that specific lifestyles are not the most
interested in new concepts of housing. In fact, most of the lifestyle groups go for
rather classic housing projects and neighbourhoods.

When we look back at the present situation on the Dutch housing market, it is evi-
dent that at least two groups of home seekers have urgent demands. First of all the
young starters on the housing market, mostly not wealthy, the demand is for two or
three rooms, preferably near the city centre. Most starting home seekers prefer to
rent in the lower price categories. Task for housing associations!

The second group are the elderly. The Dutch housing stock has a high shortage of
suitable, adapted dwellings, all rooms on the same floor, no thresholds, no slippery
floor tiles and spacious enough for care workers if the need arises. Most of the eld-
erly households prefer to rent, in several price and quality categories, so here lays a
big task and opportunity for the housing associations.

A general trend in Dutch housing is that the users of a dwelling want to have a big
say in the furnishing of the house. That goes for floor plans, for the arrangement of
utilities like the kitchen, bathrooms, as well for colour schemes, use of materials, etc.
The house has become for many households a mean to expression of their lifestyle
and self esteem. This trend is supported by government policy to give more respon-
sibility to the citizens for their own housing situation. Therefore, experiments that
give more possibilities and choices to individual households are supported. But how
cab the supply side of housing (developers, landlords like housing associations) or-
organise that bigger role of the clients? One of the most interesting concepts is IFD
building (Industrial, Flexible and Demountable Building). This concept is usable for

6 source: F.Pinkster, & Kempen, van R., Leefstijlen en woonmilieuvoorkeuren, Utrecht, 2002
7 see websites of : Smart Agent Company, Motivation, Trendbox
8 see www.ifd.nl; see several publications by the SEV (www.sev-realisation.nl)
all kinds of buildings (for instance offices, hospitals) that have a high rate of changes, and for “consumer oriented development”. A division between “bearer” (bearing elements) and “infill” (furnishing, interior elements, kitchens, bathrooms) is an accepted way of thinking and generates many new possibilities.

5. Conclusion
The new demands of customers in the housing market will be a driving force in the search for new concepts of housing production and the renovation and transformation of the existing housing stock. That goes for the rental sector and for the homeownership sector. It will be more difficult in the rental sector to accommodate the wishes of the clients, but also there are new kinds of rental contracts possible in which the tenant has more to say about the dwelling that he/she rents. All the elements of a dwelling that are not part of the “bearer” can be left to the tenant. The tenant will than own kitchen, the bathroom elements, etc. and pay only to the landlord for the renting of the “space, outer walls, façade, roof etc.”. This will however not be practical for commercial landlords, but very well feasible for housing associations. Because of their history and the willingness to listen to the wishes of their clients, the housing associations are a primary target for new concepts in housing.

In the sector of homeownership there will be a bigger part for private principals, who are responsible for the construction of their own home. This is a market that yet has to be developed. The same goes for “consumer oriented project development”, which shows in practice a logistic problem: how to get the ideas of the client from the drawing board into practice on the building site?

In any case: the modern consumer, tenant or future homeowner, wants a big say in the dwelling in which he or she is going to live. That must lead to different procedures and more possibilities for the future users to have their say in the final product: the home.

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Identifying Customer Preferences for Housing Projects

Erwin Hofman¹, Joop Halman²
¹ PhD student, University of Twente, Enschede, the Netherlands
e.hofman@utwente.nl
² Professor of Innovation Processes, University of Twente, Enschede, the Netherlands
j.i.m.halman@tm.tue.nl / j.halman@utwente.nl

1. Introduction
Companies are being forced nowadays to react to the growing individualization of demand. Previous studies have suggested that if companies want to meet these customers' needs over time better than competition, they should offer a large variety of products (Dertouzos, 1989; Kahn, 1998; Mac Duffie et al, 1996; Stalk and Hout, 1990; Halman et al, 2003). More variety will make it more likely that each customer finds exactly the option he or she desires and will allow each individual customer to enjoy a diversity of options over time. In considering the implementation of product variety, companies are challenged to create this variety economically. Thus, making enterprises more customer centric efficiently has become a top management priority in most industries (Tseng and Piller, 2003).

Also in the housing industry one might notice an increasing demand for variety. Recent research about construction firms in countries such as Japan (Gann, 1996; Barlow et al, 2003, Noguchi, 2003), USA (Kendall, 1999), Great Britain (Ball, 1999; Craig and Roy, 1999; Ozaki, 2003;) and The Netherlands (Van den Thillart, 2004) shows that several firms are exploring ways to deliver high levels of customisation in housing design. This without increasing the price too much and losing the advantages of serial, project-wise, production (Wolters, 2001). To produce this required variety economically, it is important to know how customers prioritise the different parts and elements (such as bathroom, kitchen, roof type etc.) of a house design. For parts with a great variety need several alternative solutions could be created in advance. Potential buyers will successively select the one that best fits their own requirements. Parts with a low variety need however, can still be produced as standard solutions for all homes, hereby taking advantage of economies of scale. Notwithstanding its importance, there is still a lack of knowledge when it comes to product choices that customers make in a mass customisation configuration (Dellaert and Stremersch, 2005). More specific, while interest in mass customized housing solutions becomes more widespread (e.g. Barlow, 1999; Barlow et al, 2003; Noguchi, 2003) still the prioritisation of housing attributes in house design customisation is unknown. This study therefore focuses on investigating how potential home buyers in The Netherlands prioritise the different parts and elements in a house design from the perspective of getting a variety of alternative solutions to select from.

The structure of the rest of this article is as follows. In the next research methodology section we explain the successive steps that have been followed in conducting a vignette based survey among potential new home buyers in The Netherlands. This
section is followed by an analysis of the vignettes using Saaty's clustering method (Saaty, 1982).

In addition to the vignettes, respondents also had to prioritise 35 housing attributes on the level of importance to get customized solutions. In the data analysis section the housing attributes are presented and sorted according to the relative importance of expressed customisation needs. Finally, in the last section we will elaborate on the contributions and limitations of this research and also suggest future directions of research.

2. Research Methodology

This study is based on empirical evidence drawn from a mail survey conducted in The Netherlands. A preliminary phase was spent defining our research objectives, conducting literature review as well as interviewing experts in the field of mass customized house building. After analysing current developments in the field of mass customisation in construction, the current research focused on exploring customers' priorities with respect to variability needs in housing design. Based on the preliminary literature study and expert interviews five levels of housing decomposition were identified. These are: technical systems, interior finish, floor plan, house volume & exterior and environment. These levels were used for structuring the first draft of our questionnaire.

2.1. Questionnaire design

Sometimes it is straightforward to measure priority judgements about a product or service. One can just ask the interviewee to select between two quality criteria. However, in complex decision making situations in which multiple options should be evaluated by customers, a vignette based questionnaire is preferred (Rossi, 1982; Govers, 1993; Wason et al, 2002). On a vignette, a personal or social situation is represented by some short descriptions. The descriptions comprehend the most important factors in the priority decision-making process and each description contains a well-defined stimulus component. Vignette-based studies are superior to direct-question-based studies because vignettes better approximate real-life decision making situations (Wason et al 2002). In our questionnaire design process, we followed the steps as suggested by Govers (1993): identification of relevant characteristics, creation of vignettes and collection and analysis of data. In our case the relevant characteristics consist of the five levels of housing decomposition as pointed out before. Choice alternatives at each of these levels increase customer value to some extent. The purpose of this study has been to elicit the relative weights of these choice alternatives. In this study vignettes are used to describe hypothetical housing propositions. These propositions are represented by the five levels of housing decomposition. Potential buyers of new houses had to score several vignettes with respect to the level they preferred this proposition. Table 1 outlines the levels of housing decomposition and the values linked with these levels (stimuli).

The respondents also had to score each hypothetical situation under different costs conditions. This ensures that the cost and income constraint is built into the choice experiment. A six-point semi-labelled rating scale was used for scoring the criteria (see "Appendix"); this is a so-called forced-choice response scale. Such a scale forces the respondent to decide whether he or she leans more towards the "very good" or
"very poor" end of the scale for each vignette. Figure 1 presents an example of a first-order vignette. A first order vignette defines four positive statements and one negative statement. A second-order vignette defines three positive statements and two negative statements, and so on. Maximizing the number of vignettes to be judged weighted against the respondents’ time and concentration. Therefore it was decided to present to each respondent ad random sets of ten vignettes. Respondents evaluated a total number of 21 vignettes.

In addition to the vignettes we included 35 attributes in the questionnaire. These attributes are related to the five housing decomposition levels. For each attribute respondents were asked to score the relative importance to be involved in the housing design process.

Table 1

description of vignette characteristics

<table>
<thead>
<tr>
<th>Level of housing decomposition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Technical systems</td>
<td>1 Choice</td>
</tr>
<tr>
<td></td>
<td>2 No choice</td>
</tr>
<tr>
<td>B Interior finish</td>
<td>1 Choice</td>
</tr>
<tr>
<td></td>
<td>2 No choice</td>
</tr>
<tr>
<td>C Floor plan</td>
<td>1 Choice</td>
</tr>
<tr>
<td></td>
<td>2 No choice</td>
</tr>
<tr>
<td>D House volume &amp; exterior</td>
<td>1 Choice</td>
</tr>
<tr>
<td></td>
<td>2 No choice</td>
</tr>
<tr>
<td>E Environment</td>
<td>1 Choice</td>
</tr>
<tr>
<td></td>
<td>2 No choice</td>
</tr>
</tbody>
</table>

2.2. Data collection

After constructing the questionnaire it was pilot tested within a group of four experts and ten non-experts. The group evaluated each question for clarity, specificity and representativeness. After small improvements the first draft was made ready to be sent out. The sampling frame consisted of 304 potential buyers of new houses. Their addresses where obtained with the help of a large Dutch real estate office. First we sent a letter to all 304 potential customers. In this letter we explained the meaning of the research, and we notified the respondent about a confirmation call a week later, to ask whether or not the respondent was willing to participate. Second, phone calls were made to each potential respondent. About 110 customers where reached to whom the meaning of the research was clarified. We also informed them that the survey would be anonymous; 86 persons agreed to participate while 24 refused. The sampling frame consisted of 304 potential buyers of new houses minus the 24 persons who refused to participate. This resulted in 82 respondents, giving a return rate of 27 percent, which is about average for a postal survey. The sample population represents the group of potential buyers of new single-family homes in the province of Utrecht in The Netherlands. Buyers of other homes such as apartments were not
included within our sample population. To test our research for non-response bias, 20 non-respondents were shortly interviewed. The test did not show significant consequences of non-response for our survey estimates. As illustrated in Appendix II, the confidence interval of the survey results is 0.1 and the confidence level is 0.95. This means that the survey results approximate the true populations' mean with a confidence level of 0.95 and a confidence interval of 0.1. Therefore we are 95% confident that the confidence interval (survey result ± 10%) contains the true populations' mean.

**Vignette no. 1: Imagine the following housing proposition:**
Participation in designing your future home demands a lot of time, money and effort from the customer as well as from the professionals such as the housing developer, architect and the construction company. Therefore: the more variation is demanded, the higher the costs in general will become. A standard home is a home that's offered without any variation.

- + You will have a say about technical systems (such as the type of heating (wall or floor) and the number and location of the sockets, switches and water taps).
- - You will have no say about the interior finish (such as the type of kitchen, washbasins and toilet, the floor - and wall finish and the door hardware (locks and latches).
- - You will have no say about the floor plan (such as position and size of the living-, bed- and toilet rooms, kitchen and doorways).
- - You will have no say about the volume of the home and the exterior finish (such as the size of the home, the type of roofing and the façade design).
- - You will have no say about the environment (such as plot layout, parking lots and pavement of the neighbourhood).

1 = I evaluate this housing proposition as very good, 6 = I evaluate this housing proposition as very poor

Example of a first-order vignet.

### 3. Data Analysis and Results

In this section, customer’s priorities concerning the five levels of housing decomposition are calculated by using Saaty’s clustering method (Saaty, 1982) for the respective vignettes.

#### 3.1. Allocation of weights

To calculate the relative weights assigned by customers to the five levels of housing decomposition, we applied Saaty’s clustering method (Saaty, 1982). Clustering is a way to improve the consistency of peoples’ estimations in case they have to evaluate many or complex options. Besides this, clustering can dramatically decrease the number of estimations needed. The next procedure was followed (see also table 2):

- i = a, b...e, this is the first-order vignette with a variance of attribute i;
• \( ij = (a..e)(a..e) \) this is the second-order vignette with a variance of attributes \( i \) and \( j \);
• In table 2 the varied attributes are indicated by a + sign.

**Table 2.**
Weighting method for calculating priorities

<table>
<thead>
<tr>
<th>Attribute (i)</th>
<th>Vi et (j)</th>
<th>e</th>
<th>re</th>
<th>step 0</th>
<th>step 1</th>
<th>e</th>
<th>re</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td></td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>1st order vignettes</td>
<td>+</td>
<td>a</td>
<td>0.88</td>
<td>0.03</td>
<td>0.03</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>b</td>
<td>1.94</td>
<td>0.08</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>c</td>
<td>1.7</td>
<td>0.07</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>d</td>
<td>2</td>
<td>0.08</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>e</td>
<td>0.91</td>
<td>0.04</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average weight 1st order vignettes</td>
<td>12%</td>
<td>26%</td>
<td>23%</td>
<td>27%</td>
<td>12%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd order vignettes</td>
<td>+</td>
<td>ab</td>
<td>2.35</td>
<td>0.09</td>
<td>0.003</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>ac</td>
<td>2.15</td>
<td>0.08</td>
<td>0.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>ad</td>
<td>1.72</td>
<td>0.07</td>
<td>0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>ae</td>
<td>1.15</td>
<td>0.05</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>bc</td>
<td>2.27</td>
<td>0.09</td>
<td>0.007</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>bd</td>
<td>2.28</td>
<td>0.09</td>
<td>0.007</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>be</td>
<td>1.62</td>
<td>0.06</td>
<td>0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>cd</td>
<td>1.7</td>
<td>0.07</td>
<td>0.004</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>ce</td>
<td>1.33</td>
<td>0.05</td>
<td>0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>de</td>
<td>1.35</td>
<td>0.05</td>
<td>0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25.35</td>
<td></td>
<td></td>
<td>step 3 (w)</td>
<td>0.010</td>
<td>0.026</td>
<td>0.020</td>
</tr>
<tr>
<td>Average weight 2nd order vignettes (w)</td>
<td>12%</td>
<td>30%</td>
<td>23%</td>
<td>26%</td>
<td>9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute (i)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>technical systems</td>
</tr>
<tr>
<td>b</td>
<td>interior finish</td>
</tr>
<tr>
<td>c</td>
<td>floor plan</td>
</tr>
<tr>
<td>d</td>
<td>house volume &amp; exterior</td>
</tr>
<tr>
<td>e</td>
<td>environment</td>
</tr>
</tbody>
</table>

**Step 0:** The mean score of the first order vignettes \( S_i \) and second order vignettes \( S_{ij} \) are derived from the individual customer scores.

**Step 1:** The normalized mean score \( S_i \) and \( S_{ij} \) is calculated by \( S_i = \left( \sum S_i + \sum S_{ij} \right) \) and \( S_{ij} = \left( \sum S_i + \sum S_{ij} \right) \). The normalised scores are denoted by respectively \( \hat{S}_i \) and \( \hat{S}_{ij} \).

**Step 2:** The normalised attribute-scores \( \hat{S}_{ij} \) are multiplied by the matching normalised attribute-scores \( \hat{S}_{ij} \) for the scores with corresponding \( i = a, b, ..., e \).

**Step 3:** The weights \( w_i \) are calculated by \( w_i = \frac{1}{n} \sum_{j=a}^{e} \hat{S}_{ij} \) for \( i = a, b, ..., e \). The final priority vector \( w \) is calculated by normalisation of \( w_i : w = w_i / \sum_{i=1}^{n} w_i \).

The customers’ weights from table 2 are illustrated in figure 2. As can be concluded from this figure, customers evaluate the interior finish as the most important level of housing decomposition; it has a weight of 30%. Room allocation and the volume and exterior of the home have a weight of respectively 23% and 26%. The environment and technical systems are the least important levels with a weight of 9% and 11%. The homogeneity of the participation levels is measured by Cronbach’s alpha.
(0.7933). The Cronbach's alpha is sufficient to identify the five levels of housing decomposition as a subscale.

3.2. Relative importance of housing attributes

A characteristic of a hierarchy is that it consists of levels; the five levels of housing decomposition form the maximum hierarchy for the objective participation in design, or potential product variation. To be more specific, we chose to break these levels down into 35 product attributes shown in figure 3. Besides evaluating the proposed vignettes, respondents were also asked to score each attribute's relative importance to be involved in the final design. A scale from 1 to 5 was used (see Appendix). Figure 3 shows the 35 attributes sorted according to the relative importance of customer involvement in the design process. This list will be called the Participation Growth Model (PGM). The attributes with the highest relative importance are part of the level of housing decomposition "interior finish" while the five least important attributes, except for the attribute roof finish, belong to the level "environment".

4. Contributions, limitations and future research

The objective of this study has been to explore how potential new home buyers prioritise the different parts and elements in a house design from the perspective of getting a customized versus a standard solution offered. Based upon the findings of this study we will discuss its managerial implications as well as some directions for future research.

The main outcome of this study is the priority listing of housing attributes as presented in figure 3. This priority listing is of paramount importance for all building companies who offer or consider offering customized housing. Building developers may conclude from this listing what potential buyers regard as being the most impor-
tant housing attributes between their product differentiation strategy and their estimated cost performance, the priority listing will help them in making a decision about the level of variety that can be offered to potential buyers.

Based upon this research also some limitations and directions for future research could be determined. First, this study has been conducted in The Netherlands. One might question to what extent the results will also be fully applicable in other countries. Repeating this research also outside The Netherlands will reveal to what extent

![Weight participation chart](image-url)

**Fig. 2. Customers’ priorities: Participation Growth Model**
customers in other countries differ in prioritising attributes in house design. A second limitation in our research concerns the lack of the use of a financial constraint. Although people in general prefer to have the opportunity to select from options, they will be less inclined if this option also means an increase of price. An important gap so far in literature is the lack of a model from which the willingness of potential buyers to pay more in case of varieties offered and the amount that they are willing to pay can be deduced. We suggest extending this research by also including this constraint as an important variable in future research.

An important consequence of the need to offer a variety of modules and components is that building companies will have to become capable in modularising their product portfolio. However, although methodologies have been developed recently for evaluating the applicability of modules and product platforms in different industries (e.g. Martin and Ishii, 2002), so far no systemic methodologies have been applied and tested in the specific setting of the building industry. It is suggested therefore to initiate research that could provide insight about successful methods to define and implement modularisation concepts in the building industry and investigate also its implications for the building supply chain.

Filling the aforementioned gaps in literature would be an important contribution, both from an academic as well as from a managerial point of view. We are positive that our research has started on answering these pending issues by narrowing the focus for further research but also by suggesting expanding the investigation to other countries. This will broaden our state-of-the-art knowledge about how to build customized houses economically.

References


Appendix 1
Questionnaire Customised Housing

Customer oriented house building is nothing more than building what the customer asks for. The customer may participate in for instance the design of:

- Environment; examples are paving, parking lots and playing fields;
- Skeleton and exterior finish; examples are the volume of the dwelling and choice of type of masonry;
- Partitioning; examples are position of bedrooms and the number of bedrooms;
- Interior finish and materialisation; examples are tiling and the finish of interior partitions;
- Technical systems and equipment; examples are electro technical systems and type of heating system.

Housing developers and construction companies want to effectively act upon customers' needs. We would be glad to hear your opinion about variation in design. The University of Twente has constructed this questionnaire.

General questions

If you would buy a new house, which price category would the house be part of? (amount of money in € x 1000)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>100–200</th>
<th>200–300</th>
<th>300–400</th>
<th>400 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

Have you ever bought a newly built house before?

Yes [ ] No [ ]

What house would like to buy?

Detached [ ] Semi-detached [ ] Corner house [ ] Row house [ ]

What is your age category?

<table>
<thead>
<tr>
<th></th>
<th>0-25 years</th>
<th>25-35 years</th>
<th>35-45 years</th>
<th>45-55 years</th>
<th>55-65 years</th>
<th>65 +</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is your family type?

Single family [ ] Pair without children [ ] Pair with children [ ] Single-parent family [ ]

What is your income category (in €)?

<table>
<thead>
<tr>
<th></th>
<th>Up to 10 000 Euro</th>
<th>10 to 20 thousand</th>
<th>20 to 30 thousand</th>
<th>More than 30 000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
Example of vignette related questions

For each proposition please indicate how you judge these fictive situations:

1 = I mark this situation as very good, 6 = I mark this situation as very poor.

Sums of money are in €.

Participation in designing your future home demands a lot of time, money and effort from the customer as well as from the professionals such as the housing developer, architect and the construction company. Therefore: the more variation is demanded, the higher the costs in general will become. A standard home is a home that’s offered without any variation.

Vignette no. 2: Imagine the following housing proposition:

Participation in designing your future home demands a lot of time, money and effort from the customer as well as from the professionals such as the housing developer, architect and the construction company. Therefore: the more variation is demanded, the higher the costs in general will become. A standard home is a home that’s offered without any variation.

- You will have a say about technical systems (such as the type of heating (wall or floor) and the number and location of the sockets, switches and water taps).
- You will have no say about the interior finish (such as the type of kitchen, washbasins and toilet, the floor - and wall finish and the door hardware (locks and latches).
- You will have no say about the floor plan (such as position and size of the living-, bed- and toilet rooms, kitchen and doorways).
- You will have no say about the volume of the home and the exterior finish (such as the size of the home, the type of roofing and the façade design).
- You will have no say about the environment (such as plot layout, parking lots and pavement of the neighbourhood).

1 = I evaluate this housing proposition as very good
6 = I evaluate this housing proposition as very poor

How do you evaluate this housing proposition with respect to the offered participation, if you pay:

<table>
<thead>
<tr>
<th>1 = very good</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 000 more then for a standard home?</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>30 000 more then for a standard home?</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>20 000 more then for a standard home?</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
</tr>
<tr>
<td>10 000 more then for a standard home?</td>
<td>[ ]</td>
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<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>5 000 more then for a standard home?</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>0 more then for a standard home?</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

In total respondents were presented sixteen vignettes consisting of six first-order vignettes and ten second-order vignettes.
Additional questions

Please read following list and indicate how important variation in the different attributes is for you. Score each attribute and mark it with a cross.

Explanation score, pay attention!

1 = I think participation in this option is very important;
3 = I think participation in this option has a neutral importance;
5 = I think participation in this option is totally not important.

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Environment</strong></td>
<td></td>
</tr>
<tr>
<td>a.1</td>
<td>Plot layout</td>
</tr>
<tr>
<td>a.2</td>
<td>Parking facilities</td>
</tr>
<tr>
<td>a.3</td>
<td>Pavement</td>
</tr>
<tr>
<td>a.4</td>
<td>Playground</td>
</tr>
<tr>
<td><strong>B. Volume and exterior finish</strong></td>
<td></td>
</tr>
<tr>
<td>b.1</td>
<td>Width dwelling</td>
</tr>
<tr>
<td>b.2</td>
<td>Depth dwelling</td>
</tr>
<tr>
<td>b.3</td>
<td>Choice in type of roof</td>
</tr>
<tr>
<td>b.4</td>
<td>Choice in roofing construction (e.g. dormer window)</td>
</tr>
<tr>
<td>b.5</td>
<td>Façade front (bay, glass, position windows)</td>
</tr>
<tr>
<td>b.6</td>
<td>Façade back (bay, glass, position windows)</td>
</tr>
<tr>
<td>b.7</td>
<td>Façade finish (masonry, wood, other)</td>
</tr>
<tr>
<td>b.8</td>
<td>Casements (material)</td>
</tr>
<tr>
<td>b.9</td>
<td>Roofing finish (type and colour roofing tiles)</td>
</tr>
<tr>
<td><strong>C. Layout house</strong></td>
<td></td>
</tr>
<tr>
<td>c.1</td>
<td>Length and width living room</td>
</tr>
<tr>
<td>c.2</td>
<td>Position kitchen</td>
</tr>
<tr>
<td>c.3</td>
<td>Position bathroom</td>
</tr>
<tr>
<td>c.4</td>
<td>Position toilet</td>
</tr>
<tr>
<td>c.5</td>
<td>Position inner doors</td>
</tr>
<tr>
<td>c.6</td>
<td>Number of bedrooms</td>
</tr>
<tr>
<td>c.7</td>
<td>Number of bathrooms and toilets</td>
</tr>
</tbody>
</table>

How important is participation to you?  

1 = very important  
5 = not important
How important is participation to you?  

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D. Interior</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.1 Interior walls (wallpaper, stucco)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.2 Tiling (type and colour)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>d.3 Sanitary facilities (type and colour, bath, washbasin, toilet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>d.4 Inner casements and doors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.5 Floor finish (parquet, carpet, tiles)</td>
<td></td>
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<tr>
<td>d.6 Door hardware (type of locks and latches)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>d.7 Type of kitchen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.8 Position washbasins</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>E. Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.1 Type, number and position of sockets and switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.2 Telecommunication (telephone, internet, television)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.3 Type of alarm system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type of heating (floor/wall)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>e.4 Water (combined or separate)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.5 Extra (solar system)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.6 Position water taps (cold and warm)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Where Seniors can grow
Cities for Senior Citizens

Alex Sievers
Senior Consultant, Inbo Consultants Spatial Planning & Real Estate, Woudenberg, the Netherlands
alex.sievers@inbo.com
www.seniorenstad.nl

Abstract
A Seniors City is an original living concept in the Netherlands. It is a varied community for an attractive life when over 55. The city is based upon independent living, like-minded people and a mix of facilities. Key values such as meeting places, respect, solidarity and solidarity.

Keywords: senior citizens, living communities, ageing, meeting places, solidarity, respect, volunteerism, network city

1. Initiative
We at Inbo took the initiative to, together with the Stuurgroep Experimenten Volks-

huisvesting, Heijmans IBC Real Estate Development, BAM Real Estate, ING Real Es-
tate and the housing corporation Rochdale, study the chances and feasibility of a city
for seniors in the Netherlands. A Seniors city is a varied community for an attractive life when over 55. The city is based upon independent living, like-minded people and a mix of facilities. The word city though is not the size itself, it's the dynamics and the togetherness of the people. Seniors city gives another choice. September 2004 our study has been published. Since then we are in the process deepening or engi-

neering of themes such as well-being, care, physical infrastructure, parking as well as the process steps.

2. Ageing of the population
The reasons to start the study are various. To give a few: the ageing of the population, the returning interest in community feelings, the lack of solidarity in many neighbourhoods, the not so many choices we have in choosing the community we want to live in (unless you have the money), the demands of the senior citizens and the new moral values. Also the economy is a reason to start our study. It is a fact that every retired person creates a 0.2 number of jobs. And a last reason is the result of a study by NIZW, "Loneliness at age", where in our country of 16 million people and 4 million seniors there may be up to 1 million lonely elderly. I think, that these are good reasons to think of new types of communities. Not in stead of the existing ones, but as an addition and as an alternative. Seniors city can be one of the interes-
ing concepts. Important is to see the senior citizen as a chance in developments, not as a problem.

A city for senior citizens has good opportunities in the nearby future in the Nether-

lands. People like to live in environments where they can stay human. A city for sen-
iors is such kind of environment where the inhabitants can experience solidarity and will have a useful, respected and warm place in our society. A society where they can be proud of. A safe and secure community that inspires to be active and where care is present, but on the background.

In our means a city for seniors is a logical element full of identity in a network of cities and towns. Not a living area that is isolated from the rest of the world. With the areas around the seniors city there will be a natural exchange of people, goods and knowledge. A Seniors city is also more than just living. Because of its specific characteristics can Seniors city gain a dominant position in an economical cluster. To give a few examples: Seniors city can lead to innovations in and around the house, in recreation, medical aspects, special traffic and transport, parking and the environment.

Seniors city gives the main starting point to realise forms of living where activities and sociability stand central, and where in the globalising society of today social cohesion and solidarity are the focus. These themes rapidly gain in importance in our society. Regarding senior citizens there is an added interest knowing that their distance to the competitiveness in our culture is growing. Seniors city therefore is not a city where the materialistic focus on more more more is leading. Values and identity are in the spotlight.

3. Enlarging possibilities

Seniors city is an original living concept that can enlarge the possibilities for the elderly. Especially in the choices of the living environment there is not so much to choose in the Netherlands. In one way this is a result of our approach based on integration. That's not a bad approach however, and has led to various nice neighbourhoods. But also to very average environments, that are not tailored to its audience, its inhabitants, the society. Seniors city however has its focus on the social-cultural qualities. The identity gained in this way is not one that is primarily based upon arguments in urban design. It is the social, economical and cultural values that build Seniors city. Choices that people make are the device. It is possible for every Dutch to choose, within his own limitations, for a neighbourhood or community that fits his lifestyle.

For the elderly, choices are as important as for anybody else, whether they have a high income or a low. For years we, however, didn't want them to choose. Despite our many good means our policy is not to let the elderly manage their own lives, fitting their own needs of care. Much too often we have to state that the silver part in our society feels unhappy with the way they are lived by the others. They would have preferred to live themselves and their lives fitting their own demands and ambitions. Dependence and ambitions often struggle.

Of course physical problems will occur more in Seniors city than they do in the society we know. In the softening of the pains the informal assistance however offer more possibilities as well than they do in the society of today. The concept of Seniors city is, as we know, based upon the mutual care and handiness. This could be a thread in successive phases in life: enjoying nice things together and, later, sharing care.
4. High interests

A city or neighbourhood for specific target groups such as the senior citizens is not new as a typology. In the United States the first community for senior citizens dates back to the 1960s. In the Netherlands it is however not a common typology.

Within the Netherlands there is an enormous potential of people aged 50 and over that are interested in living in a Seniors city or neighbourhood. In a survey 42.9% of the people 50 and over said yes when we asked if they want to live in a Seniors city. Considering that the Netherlands has over 5 million seniors nowadays – and that number is still growing – we’ve got a potential of 2.2 million inhabitants. Apart from the 42.9% that said yes, a group of 30.9% said maybe. That’s another 1.6 million people that may be attracted with a Seniors city.

Table 1.
Interested in living in a Seniors city or -neighbourhood

<table>
<thead>
<tr>
<th></th>
<th>number</th>
<th>percentage [%]</th>
<th>50+ [mio]</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>147</td>
<td>42.9</td>
<td>2.25</td>
</tr>
<tr>
<td>maybe</td>
<td>106</td>
<td>30.9</td>
<td>1.62</td>
</tr>
<tr>
<td>no</td>
<td>90</td>
<td>26.2</td>
<td>1.38</td>
</tr>
<tr>
<td>total</td>
<td>343</td>
<td>100.0</td>
<td>5.25</td>
</tr>
</tbody>
</table>

source: Inbo, Enquête seniorenstad 2004

It’s the key values that make the interest in living in a Seniors city: solidarity, respect, meeting places, enjoying life and independent living combined with a significant place in our society among people they want to know.

5. Target group

The target group for living in a Seniors city is various, and lies somewhere in between the people that leave the Netherlands for a permanent or semi-permanent house in Spain or Portugal and the ones that stay in a Dutch caravan park the whole spring, summer and autumn.

Table 2
Typical aspects and interest in living in a seniors-city

<table>
<thead>
<tr>
<th></th>
<th>interested + maybe</th>
<th>percentage [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>gezellig ('cosy')</td>
<td>172</td>
<td>69.4</td>
</tr>
<tr>
<td>active</td>
<td>156</td>
<td>62.9</td>
</tr>
<tr>
<td>committed</td>
<td>142</td>
<td>57.3</td>
</tr>
<tr>
<td>individualistic</td>
<td>65</td>
<td>26.2</td>
</tr>
<tr>
<td>attitude of expectation</td>
<td>48</td>
<td>19.4</td>
</tr>
<tr>
<td>following trends</td>
<td>18</td>
<td>7.3</td>
</tr>
<tr>
<td>retired</td>
<td>13</td>
<td>5.2</td>
</tr>
<tr>
<td>trendsetter</td>
<td>10</td>
<td>4.0</td>
</tr>
<tr>
<td>inspired</td>
<td>10</td>
<td>4.0</td>
</tr>
<tr>
<td>different</td>
<td>7</td>
<td>2.8</td>
</tr>
<tr>
<td>total</td>
<td>641</td>
<td></td>
</tr>
</tbody>
</table>

source: Inbo, Enquête seniorenstad 2004

Southern Europe for them is too far away from their social networks and on the other hand, the caravan parks do not offer the comfort they prefer. As in Spain and
the caravan parks the target group for the Seniors cities has a feeling for sociability, likes to be active and involved in society. These aspects we see in our survey as well: 69% of the respondents likes sociability, 63% considers themselves as active and 57% is socially involved.

The respondents on my survey that do not want to live in a Seniors city are much more individualistic. 45% says to be individualistic while only 26% of the respondents that wants to live in a Seniors city feels that way.

The future inhabitants of Seniors city are no trendsetters, although in a way I think they are, considering that they want to be there for the people living in the same community, the people that like to grow as they do.

6. What to do in a Seniors city

Seniors city is going to be a green environment where there is much to do, much to experience. A community where safety and security are obvious. The future inhabitants like to meet each other. Recreational facilities will feature that. Important are social clubs, hobby clubs and sports clubs. Important as well is to develop these facilities together with the future inhabitants. Not for them, but with them. Seniors city is not a flight from the society. It is its attractivity that calls. In the words of Del Webb, the developer of the first Seniors community in the USA: “Welcome to a place of scenic surroundings, world-class amenities, and finely crafted homes. A place where you can set your own course, discover new pursuits, re-discover old passions, and call each and every day your own. Welcome to the life you deserve.”

The housing types in Seniors city are divers, the largest number not being high-rise condominiums, but bungalows, villas or attached houses in a row. The atmosphere will be one that is more rural than it has the hectic 24-hour economy of the highly urbanised large cities. Of course, the density can vary according to the nearness of the facilities. Important is the human scale and the familiarity of the real estate in Seniors city. Anonymous buildings should be avoided. These will only lead to more loneliness.

Considering the huge demand it is necessary to start the further developments as soon as possible. Not on one location, but on more at the same time. In that process we must not make the mistakes we made before. It is wise to accept differences fitting the identity of the people, for instance in different areas in our country. Let us not think that all men are the same with the same wishes and demands. Let us stay close to the people, the regional strengths, the identity and contexts. I think that an approach like this will have good opportunities in newly built estates, restructuring of older neighbourhoods as well as around villages.

7. Top-down and bottom-up

The process towards a Seniors city will be one with a mix of top-down and bottom-up initiatives. The top-down approach gives the framework in most of all the physical and economical components. Bottom-up there attention for the social and cultural needs, for the personal and co-operative demands regarding spatial possibilities, leisure and the involvement in boards, clubs and so. To be successful it is necessary to link the activities and involvement as much as possible with the own interests of the citizens. Volunteerism and club-life can play an enormous role in these projects.
This bottom-up approach has another advantage. It creates a commitment in early phases to be used in the longer term as well. And, it gives a base should the future citizens feel a need to develop CC&R’s (Codes, Covenants, & Restrictions).

8. The next phases

Where in the process are we now? Knowing that there is a huge demand in numbers as well in the quality of life, we are taking the next step. The first one is the development of a spatial concept of Seniors city for a location in the Netherlands. In my country we have many opportunities for good locations. Some factors for success are:

- within 45 to 60 minutes of larger cities,
- a high accessibility by car and public transport,
- attractive recreational environment,
- authentic character – so use of the present characteristics,
- village atmosphere in social means but a city in its diversity on facilities.

I guess these are facts that not only comply for a Seniors city. Nevertheless it’s not just the external factors that make Seniors city, it’s the quality of life within. To be more specific on locations, the former airport of Valkenburg near Leiden is a good place, or the rural area just southwest of Utrecht. Being central in the Randstad, the most urbanised area in our country, these may host a large Seniors city. Smaller versions of Seniors city can be very well developed in Zeeland or Drenthe, some of the more rural provinces. And third, the Morgenstond neighbourhood in The Hague is a perfect place to be redeveloped as a Seniors city. Just to give a few examples. I did not study the opportunities outside the Netherlands, but it should be interesting and effective to regard a concept like Seniors city on a west European scale.

Fig. 1.
The second issue in the phase we are in now is the deepening or engineering of themes such as well-being, care, physical infrastructure, parking, housing concepts, volunteerism, employment, ICT, the art of getting older, the balance between bonding and bridging and the feasibility of the social infrastructure to name a few. We will lay down the results in what we call a Structure Quality Plan, a guideline that shows the value of Seniors city in comparison with other neighbourhoods. Also the scale of Seniors city is a topic here. In my opinion a seniors city should be small enough to give the citizens the feeling of home, but large enough to make new incoming movement possible. Let’s not build an area that is happy and vivid today but may result in 100% citizens that need care in twenty years, because everyone is over 75. And, I think a Seniors city should be large enough to make a large number of facilities possible and feasible.

The third issue deals on the organisation. I mentioned before that Seniors city will be a mix of top-down and bottom-up initiatives. There will be no Seniors city without the future inhabitants working on it themselves. But how is this process being managed? We’ve made a start to create regional workshops with both professionals and citizens.

Last but not least the political, public and private support is important. In our communication I think some things are important. I already told you about the key values such as solidarity, meeting places, activities, sociability, safety, significance, pride and independent living. We communicate by means of these themes, combining it with the freedom of choice and the possible innovations through Seniors city. Within the last months about 100 different media have paid attention to our plans. Most of the media have presented the concept of Seniors city quite open minded.

9. Vitality by smart phasing

It is important to realise a living environment that has enough dynamics to keep the spirit alive. To be attractive for the younger senior without losing sight on the older ones. Just because of that the size of Seniors city has to be larger than only some hundreds of houses. Although we are working by now on the optimum size, we estimate a size of about two to four thousand households offers a suitable base. A size as such gives opportunities for phasing directed to lasting qualities. So Seniors city will be vivid and vital within 25 years as well, and is not exclusively the place for 85 and up.
Many of the key values we mention are interesting for others than seniors. So why a age restriction. Primarily to make meetings between people really possible. As we look to many of the nowadays neighbourhoods, we see streets with lots of two-income households that do not have the time to participate in their neighbourhoods – although they might want to. Their efforts in the solidarity is small, certainly considered form the point of view from the senior with different day schedules. Of course we know that many seniors still have jobs. Nevertheless among the seniors there is a more or less shared feeling and attitude towards life. One that is less competitive and with an own spirit. Not as fast, but as valuable as from younger people.

A Seniors city. An attractive environment where seniors can choose for themselves as one of the housing concepts for the future. A place where they like to live and grow. A community where people can enjoy life, and can be there for others as well – within and outside the Seniors city. In the Netherlands there are have many good sites already. It's time to act, to get serious in satisfying the needs and demands of so many senior citizens. Not for them, but together with them. Let them grow. Let them meet.

References

An industrial gap in the housing market?

Han Michel
Independent advisor on housing (after directorships of several housing corporations)
hmichel@xs4all.nl

1. A radical new alternative
The initiators of this symposium 'Concept House' have the ambition to "offer a radical new alternative for the current housing architecture by enabling a living environment with a high but consumer oriented industrial quality with new suppliers, new materials and techniques".

What could we see here? First of all we see that the goal is an alternative for the current housing architecture, not for housing production. Second the word "but", which connects two opposing thoughts: "A high, but consumer directed quality". Do the initiators doubt the match of industrially produced houses with the preferences of the consumer?

On the consumer's side it will not be easy to beat the negative image of the rationalized housing of the sixties and seventies. The connotation of 'industrialized housing' comes in to a conversation with a picture of the merciless gallery apartment flats. That would be the last housing type the consumer would choose.

2. More of the same
What does he want, the average consumer? How can one play on preferences with products of industrial housing production? The Social and Cultural Report of 2004 is clear about the housing desires: "Suburban living is the preference of most Dutch, except for the working or studying individuals. Also foreigners chose for living in outskirts and border communities and for private one-family houses". Wishes for the future are more of the same, with newer and somewhat bigger houses, bigger lots and better parking spaces.

The interest for own houses is large. The share of rental houses in the housing supply will gradually decrease. The range of clients is changed, too. The housing associations are becoming less important as clients, seen their strongly reduced share of cheap rental houses. Institutional investors aim with their more expensive rental houses at smaller, specific markets. Developers follow the forceful signals given by potential buyers on their preferences. The influence of the economic climate is strong. Now that the housing market is weak, the supply is focused on the most popular types: one-family houses in the cheap middle class and modest apartments. Housing production is at a historically low level: around 60,000 units a year.

3. Hand-molded bricks
How do the new houses look? From the 13th century bricks have gradually won in popularity in buildings over natural stone and timber. After the 16th century bricks became the most important material for houses. Only in the sixties of the last cen-
tury this position was questioned by the triumph of large concrete façade components. As a structural material bricks have lost their importance, but as a façade material bricks are still convincingly at the first and most important position: 90% of new houses in the Netherlands are built with a brick façade. More in detail: 13% in extruded bricks, 24% in form-bricks and 63% in (mechanical) hand-molded bricks. The Dutch Society of Brick Industries has thought out an efficient market approach and anticipates alertly the developments and trends in architecture. In Amsterdam a new showroom has been opened where 2800 different bricks are shown in a serene setting [Wienerberger: Terca’s ‘Stenotheek’].

Fig. 1. Wienerberger: Terca online Stenotheek [www.bakstenen.nl]

4. Value development

For buyers the expected value development of houses is important. Surely now the turnaround of collective pensions to individual arrangements explicitly has been announced, this aspect is of growing interest. Capital of people often is built in their own houses. A positive growth of this value is crucial. This is the driving force behind ‘gated communities’, communities with often drastic, voluntarily accepted rules. Building styles that expressing long lasting stability are quite popular: historical architecture, ‘Berlage style’ or the popular thirties style.
Owners prefer a building which ages beautifully. Time has to become a friend of the building. The living environment and the house obtain an expression in time which characterizes certain people of middle age. Traditional building materials win the day clearly. Very few new building materials have shown to age beautifully.

The Social and Cultural Plan Office signals that the inside of a house has become more important to express the identity of the house occupant and also the increasing need for comfort. Kitchens and bathrooms are not seen as real estate any more, which is changed and renewed continuously as taste develops. Interior reconstructions simple materials and do-it-yourself materials play an important role. The flexibility in use of the house improves with the neutrality of the structural support frame and the skill of your brother-in-law. The simplicity and force of this formula has resulted in efforts on the field of industrialized and demountable building being in vain. The technology of the house, the least durable part of the house with its ever changing rules and regulations, often hinders flexibility in use.

5. Individualization

Living behavior changes unmistakable but slowly. The house supply only grows very slowly at a rate of 1% per annum. Demand is bigger than supply. Residential preferences often cannot be fulfilled. The most important trend is the irreversible individualization. Households are becoming smaller, the house occupation descends. In the last 30 years 1.5 million singles have entered the market. In the coming 30 years one expects another 1 million singles extra. Slowly politicians face up to this group of people, mainly due to the problems of starters. W could imagine a scenario with suburban preferences for families and elderly people with a quiet life rhythm and on the other hand an urban preference for working singles with a flexible and dynamic life style. Singles and households without children have a stronger representation as the living environment is more urban. In the larger cities most of the households exists of singles.

6. Mobility

In many respects mobility increases. In the Netherlands the distance between places of living and working increases. Jobs with lifetime guarantee are scarce. Many people have an international orientation, in work and in relationships. This leads to a new demand for temporary living situations: 'short stay' and second houses. As for now this seems to be a small partial market. For this demand small houses are not pitiful. Comfort rules. In Paris one third of the houses inside of the 'periferique' exists of small studios, with an average size of only 26m2. Maybe the international market of the 'Smart' apartments offers advantages for industrial production.

7. Students

Housing of students has been entangled by the overloaded housing market in the cities. At choosing a university housing plays an important role. Some parties, amongst them housing associations, stimulated for the first time to compete, have developed energetic initiatives for larger projects with temporary units for students and youngsters for available locations. This concerns thousands of units. Only in Amsterdam more than 2.250 units are realized (inclusive a former cruise ship, with plans for
2.750 units more. The temporary situation makes procedures shrink and one can work with enlarged decisiveness. The units are built up from existing systems for building site sheds or even sea containers from China. Design expresses temporariness. For the initiators of this symposium it would be interesting to research how the building industry has reacted on this suddenly flourishing partial market of quickly realizable standard units.

8. Cepezed

In 2004 Emo Stedelijke Ontwikkeling bv, a daughter company of AM Wonen, asked architectural firm Cepezed for a design of a smaller house of 55m2 incorporating modern technology, organization for realization, suitable for starters on the buyers market. Before them Claus en Kaan Architects had designed the basic Studio, a small and flexible studio for urban locations, to be built in traditional manner. During the acquisition of this project and the running trial series a number of important experiences were gained. It appeared that decision-makers and administrators are sensitive for a unique architectural proposition (custom-made) rather than for a fully developed product. On top of that many urban locations know a far-reaching quality assurance, with Q-teams and supervisors. Running through a complicated process, in which different parties can exert their influence is essential. The studios of Cepezed are installed on the building site quite fast by the different suppliers. The risk taking main contractor is not present, as this is the usual working model of Cepezed, so that the client au fond also bears the risk of construction. This profile does not fit the risk management of the modern project developer. A good location and an attractive pricing are necessary in order to interest the market for technically advanced houses. This aim often does not coincide with the municipal land policy.

9. Conclusion

The housing production has not changed in essence in the last decades, but it was quite rationalized, both in the individual houses (like catalogue houses) as in the serial house production. Professionals have put more emphasis on the preparation phase, the development and the construction engineering. Industrial houses did not get a foot on the ground. Developments in supply of houses do not lead to new chances for industrialization over the full width of production of houses.

The research group Concept House as the organizer of this symposium ‘Concept Housing’ has a product driven approach. A supply market is developed for a more or less defined product, the radical alternative for housing architecture. May be some trends in the fragmented market could offer perspectives for new materials and techniques, with an expressive modern architecture as a result. Think of partial markets for students and youngsters, inclusive temporary solutions and the compact studios, ‘pied-a-terres’ and short-stay units. One could also imagine a demand driven approach where the preferences of consumers are the points of departure. This could lead to semi-modern concepts like an extreme industrialized supporting frame structure with a flexible infill of the envelope, fully as desired by the occupant. In such a commercial approach a larger part of the market could be discovered. Not the ‘radically new alternative for the current housing architecture’ would be the target, but the supply of an alternative in price and quality, by means of industrial production.
Fig. 2-3. Isometric drawings of the dwellings for starters, designed by Cepezed. [Fig. 2-6. courtesy of Cepezed Architects]

Fig. 4. Plan of the dwelling

Fig. 5-6. Clustering of the dwellings and photomontage of situation
Market Target Groups of Concept House

Sannie Verweij¹, Mick Eekhout², Jos Lichtenberg³,
¹ PhD researcher Concept House, Faculty of Architecture, Delft University of Technology, The Netherlands
s.verweij@bk.tudelft.nl
² Professor of Product Development, faculty of Architecture, Delft University of Technology, The Netherlands.
m.eekhout@octatube.nl
j.lichtenberg@bwk.tue.nl

Abstract
This article concerns the marketing of customized & industrialized houses, and the prototype forms of concept houses in particular. 'Concept House' is a research-by-design group started and based at Delft University. The group tries to bring new ideas and concepts to the housing industry in order to generate a complete new technical approach to housing. The new approach would involve off-site industrial production techniques in order to built houses that are both industrialized and customized. In this article five target groups are described for which customized & industrialized houses would be a good option.

Keywords: Concept House, Marketing, Partial markets, Customisation, Lifestyles

Introduction
In the research project Concept House, we work on new concepts for building industrialized houses and hope to complete the research after 4 years by realization of real scale prototypes. Although history proves otherwise thus far, we think that a more industrialized way of realizing houses can be used for building houses for the Dutch (at first) and Western European (later) market in the future. In contrary to the historical housing projects our goal is not industrialization in itself, but the customized form of industrialization could be the solution for a number of problems in the Dutch / West-European new housing market.

In the Start Report Concept House, May 2004, [1] Mick Eekhout has stated that Concept House will prepare a Western European market for industrialized housing. By generating and inviting competition to create a dialogue on alternate housing, publications on customised industrialisation will follow and the design and development of Concept Houses can respond to market analysis, providing alternatives in the housing market. It is expected that such customised industrialised housing will be a reality within five years. This plan still holds.

As the first PhD student my initial activities in this research project not only concerned setting up the foundations of the entire research group, but also an evaluation of the historical examples of industrialized housing and the reason of failure behind them. This article is the result of the first steps in this process and shows the market potentials of Concept Houses. In this market study the most promising five partial market groups of potential inhabitants are identified for the new concept of
customized industrialized houses. We will use the outcome of this market analysis as a guideline for the designers of customized, adaptable and industrially built houses in the near future.

In the first chapter an introduction on the history of Industrial Housing is given with a special focus on the marketing aspects. In the second chapter marketing aspects of housing, industrial buildings and Concept Houses in particular are described. In chapter three the results of a global market study are given. In chapter four some considerations on market research for Concept House are discussed. In chapter five the final choices are made for the five most promising target groups for Concept Houses. In the last chapter the theme is further elaborated and conclusions will be drawn.

![Concept House](image1)
![Concept House](image2)
![Concept House](image3)

Fig. 1. Start Report Concept House [1]
1. Historical Background

1.1 History of Industrialization in Housing

Industrialization in the building industry is not a new idea. The building industry picked the fruits of industrialization long after the mechanical industry had exploited it. In the 19th century in general no large scale industrialization occurred in the building industry, only in the production of elements and components to be used on site, like for example iron casting, steel profiles, conduit piping, water closet systems, glass production and bronze windows. The higher level of assembly, in which buildings are produced as total artefacts, was not reached and the building sites were not industrialized. The Modernist architect Ludwig Mies van der Rohe (1886-1969) made a recorded plea for industrialization in the early 20th century (1924): “In the industrialization I see the main issue of construction in our time. When we can manage to carry through the industrialization, social, economical and even artistic questions can be easily solved.” [2]

A first analysis of a number of relevant historical examples of industrialized housing shows that the emphasis often was put on prefabrication and the technology of industrialization itself. The reasons for prefabrication are rooted in the optimisation of the building methods and were never derived from expectations or requirements from the customer’s side. An extreme shortage of houses was in many cases the driving factor to inject industrialization for fast track building from the supply side. The demand side was not very powerful. Due to the shortage of housing, there was no choice for customers.

1.2 Historical overview

In the 1960-ies industrialization of housing on the building site was introduced by main contractors in the form of large scale scaffolding and moulding systems for pouring reinforced concrete as the load bearing structures of apartment housing blocks. The craning and railing necessitated by these industrialized large scale concrete building methods were included.

In the seventies the first short upheaval of industrialization in the building site industry of housing came to an end when after the social revolution of 1969 individualization in society and in the design of housing complexes came up. Up to that moment more than 10 prefab concrete component factories were active in the housing market. None of them was versatile enough to follow the whims of architectural plans. The fact that houses had to be built in varying steps in plan and elevations leads to many different concrete components instead of a basic and very repetitive small assortment. Architect as the representatives of the future inhabitants, wanted to express individualism of inhabitants in the housing blocks and arrangements. The market shifted in order to satisfy more to the social requirements from the demand side. At the end of the 1970-ies only one factory of reinforced concrete components survived. In the 1980-ies the fierceness of the architectural 'jumpiness' calmed down and housing blocks regained more austerity. The urban design schemes of housing quarters took over the trend of the surprise effects and the individualization.
In the last decade the production in number of realized housing decreased dramatically. From 150,000 houses per annum in 1970 down to hardly 53,000 in 2004. The supplying building industry reduced its productivity to artificially maintain this situation of shortage in the market that is profitable for them.

1.3 Three Typical History Cases

Many industrial housing projects were started in the last 3 decades. Three of those are selected and described here as case studies because of their specific marketing problems (for 8 case studies, see appendix M. Eekhout). These projects show that marketing problems can be very diverse. And even though some of these projects had a marketing plan, they still encountered problems in this respect.

Marketing Problems Lustron House

After World War II, The US Government had an interest in creating new housing for returning servicemen. Carl Strandlund founded the Lustron Corporation and built approximately 2,500 Lustron Homes in a former aircraft plant in Columbus, Ohio. Marketing experts claim Lustron failed to establish an effective national distribution system to handle its high-volume sales. A second reason is that the returning servicemen, who were the main target group, could not obtain mortgages due to their unemployment and where therefore unable to buy a Lustron house. Ultimately, the Lustron’s price may have been the deciding issue. In a pre-fabricated housing market with average prices ranging from $5,500 to $8,500 (land excluded), the two-bedroom Lustron Home model cost $10,000 to $12,000. The failure of the Lustron House is caused by the overrating of the potential market share, which influenced the number of produced numbers and therefore also the planned production line and ultimately the price.

Fig. 2. Lustron House

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1 According to Centraal Bureau voor de Statistiek the total increase of housing stock for 2004 amounted to 52,296 (kerncijfers: Veranderingen in de Woningvoorraad 2004).
Marketing Problems Futuro House

Matti Suuronen was assigned to design a modern ski cabin in Janakkala, central Finland. Despite international attention the Futuro Casa Finlandia never became a commercial success. Two reasons could be mentioned for this failure: 1. The oil crisis of 1973 caused the price of plastics to triple; 2. A large order for the Olympic Games of 1980 in Moscow was cancelled due to a lack of funds after the boycott of the USA, Japan and parts of Western Europe. (caused by the Soviet Union raid in Afghanistan).

Fig. 3. Futuro House

Marketing Problems Matura System

[See also the article by prof Age van Randen in these proceedings]

The Matura system relies on the fact that all installations belong to the infill except for the main supply and return ducts. Regardless the great technical advances the product was not accepted by the market, especially by the main contractors. The profit of these contractors would partly be absorbed by Matura, who itself explicitly did not want to act as a main contractor and become main contractors in renovation projects. Therefore contractors were not interested in the product, but Matura did not think of an alternative option. The shareholders of Matura stopped the project after a while.

Fig. 4. Matura System
2. Marketing in the Housing Industry

2.1 Marketing

Marketing only exists if there is a supply and demand for a product. Newly introduced industrial made products need to come together with a good marketing plan. According to www.QuickMBA.com/marketing [3] there is a difference between Market Research and Marketing Research. “Market research deals specifically with the gathering of information about a market’s size and trends. (...) Marketing research is a more general systematic process that can be applied to a variety of marketing problems.”

A good marketing research starts with good description of the product and the associated goals. Subsequently a situation analysis needs to be done. In this situation analysis the company, the customers, the competitors, the collaborators and the climate are analysed. After the situation analysis, market segments or partial markets need to be determined. After that a marketing strategy can be selected, explained by using the well-known 4 P’s of marketing: ‘Product, Price, (Distribution) Place and Promotion’.

The TU Delft based Concept House Research Group is not a commercial company, but in pursuing effectiveness and efficiency marketing plays a key role for appropriate designs. The results of the research group will be:

- The first design concepts of houses as artefacts and houses in urban clustering;
- The technical developments of the design concepts with the production and assembly techniques;
- Material prototypes on the component level and the element and material level in order to test them;
- The associated guidelines and design rules for developing industrialized customized houses as artefacts and in components, elements and materials;
- Plan of logistics for production and market launch.

In order to do so, not all parts of a marketing research are necessary in the first year of the Concept House Project. But since we have to take into account the future applicability, an indication of the partial markets would make sense to direct the design and efforts.

2.2 Industrial Marketing

In the marketing of new customized and industrialized housing the basic principles of consumer marketing are not always easy to imply. A difficulty is that a house is more an investment object than a commodity. A house as real estate is usually rising in value, consumer products on the contrary can be thrown away with no rest value. This real estate characteristic of never becoming a resting zero value leads to the following problem. In the marketing analysis of newly to be build houses the biggest market share is that of the existing houses (98 to 99%). In times of bad economy for other products the bigger companies keep the prices at high level. But in the housing sector, the many individual sellers are willing to lower their price (Ball M., 2003 [4])

The marketing of new houses in the Netherlands is even more specific. A well-known citation for the real estate world is that marketing of houses not have to deal with
the four P’s but with the three L’s: ‘Location, Location, Location’. Nothing else seems to matter.

Furthermore the suppliers are not used to marketing either. Where product designers are educated to design for unknown customers, the architect is educated to design a tailor-made house concept for a fixed user. Often the architect acts as if he is the future customer, aiming to sublimate his design to a work of art.

On a lower scale (of materials, elements, components) innovative product development in the building industry is hold back by several reasons. In the building industry every project is seen as an independent project. Profits need to be made within each given project, debiting is done within the limits of each project and further development on existing products or designs is not usual. In the building industry a separate R&D department is not a common habit. (Lichtenberg, 2003[5])

By designing a new strategy for selling industrial houses, all these factors should have their influence on the plan.

2.3 Marketing of Industrial Houses

The image of industrialized house is not very good. A good promotion strategy will be necessary before launching new products. But also during a design process for research purposes, the image of the future building has to be kept in mind. It might be interesting to design very industrial looking buildings as complexes for concept houses but the market share for traditional looking buildings might be better. Interviews with consumers will probably give the idea that people only want those traditional materials. Both industrial and traditional looks are applicable by using industrial building techniques. So the choice of materials and the production method is not a decisive or evident fact in the design process.

3. Market Research

3.1 Market Research in Housing

Often market research is carried out by interpreting the statistics on housing made by the government. The numbers to be derived from statistics might seem very interesting, but are in fact completely useless to define a direction for new concepts for dwellings. The statistics are about the history and might be able to tell something about the present, but never can forecast the future. This future encompasses a new design with its own characteristics within a new urban environment and an encircling political, economical, employment and social environment. And this is future does not fit into statistics.

Another way of marketing is research about what consumers want. In the Netherlands this is quite difficult. The consumer does not know what he wants, because normally he has not any choice. At least he does not have the same choice comparable with the choice of buying a car. In countries like Belgium and Germany, consumers do have a wider choice for their housing facilities. The lack of options might lead to no choice at all because there is only one supplier.

Also the availability of building ground influences the lack of freedom. In the Netherlands building ground for freestanding houses is scarce. The most ultimate action to reach a free market and an opening for industrialisation is to break through this constipation on the ground affairs. We think of a process that is controlled by town
planning by keeping some plots available for building freestanding houses. Just like every municipality needs to have a caravan site as well. Possibly we can develop a proposal for this as part of our project together with colleagues of Real Estate and Housing and the OTB.

3.2 The Dutch Housing Market

The game of supply and demand in the Dutch housing market is quite complicated. Each year only 1 to 2% of the total housing volume is added. The currently available houses are grossly built over the last 150 years with a great part of them post-war houses. A supply driven market has clearly other product characteristics compared with a demand driven market. The housing market of newly build houses in the Dutch ‘VINEX’ locations shows this. “VINEX” is the abbreviation of fourth note on spatial planning made by the government in 1993 in which areas are assigned as a extension area for the cities.

![Fig. 5. A random example of a Dutch Vinex Location](image)

In a supply market, due to overwhelming supply, the customer can choose between different products. Customized housing results in serial building of houses, with specific attention for and answer to the individual wishes of consumers, like more freedom in plan design, more options and better suited accessories. Consumers determine or choose a considerable part of their own dwelling in these cases. The combination of large scale or ‘mass’ industrialization and providing space for individual choices and options is quite common in the modern car industry. This ‘mass customisation’ or mass individualization however is new for the housing industry. But when
years after each other fewer houses are built and at the same time social circumstances are developing, large unfulfilled demands are the results.

3.2 The Changing Housing Market

The desired tendency in the market for housing is the change from a supply driven market to a demand driven market. However, it is stopped at shortage of supplies. In the Netherlands there is a shortage of specific types of houses, amongst them cheaper houses for starters, and amongst them a group of youngsters wanting to leave their parent houses and start living on their own.

But the time is changing; the quality is becoming more and more important in the housing marketing. The quality is determined by the regulations of the government and these regulations are getting more and more stringent. These regulations not only contain minimal requirements for comfortable living and better sustainability performance during the user phase of the building, but also demands for the building phase, such as less building waste, less use of energy and regulations for the craftsmen on the building site.

Additional to these problems on the supply side, the society is changing as well. Due to the wide and relative cheap availability of cars, the rail network and the Internet, groups of consumers with the same type of work or the same religious belief are not living together as a community anymore. People become more and more individual and therefore housing becomes more individual. Collected behind a common façade
of a larger building only individuals are living. In the information era consumers have almost infinite access to product information. They are exposed to an overwhelming number of choices.

4. Considerations around Market Definitions

4.1 Market Considerations

Apparently it seems not really significant to do a lot of market research in this stadium of the design process. It is better to design parallel concepts from hypothetical choices for one or more target groups with different approaches. The overall target groups stipulate then to fill in the programme of requirements.

The investment decision which happens afterwards (to develop, develops, sets up process, venture, etc.) can possibly be taken then after a provisional confrontation with the market. At that future stage effective market research has more value.

The presented marketing strategy at this stage is therefore rather concerning marking an aim market of demand (expressed in lifestyles) and supply (our possibilities limited constraints) then establishing and implementing a market research.

Thinking in target group definitions becomes more and more common, the lifestyle groups acts as the ‘problem’ on the demand side, while options, accessories, increase possibilities, fixed versus variably form the ‘solution’ on the supply side.

4.2 Definition Target Group

Description of a target group: a well-defined, measurable and constant group of customers, to whom you can communicate easily as a group. A target group differs from another group if it produces another marketing mix by difference in price, product, (distribution)place and promotion. And it most important: a target group must produce a substantial contribution to the quantity in order to get a good industrial production line and a profitable products. Target groups can be analysed by different characteristics.

4.3 Segmentations in Target Groups

(www.quickmba.com [3] and Start rapport marketing Concept House [6])

Geographical segmentation is based on regional differences, like climate, population growth, housing density and housing typologies.

Demographic segmentation is based on measurable differences of the consumers, such as age, ethnicity, education, income etc. If a demographic segmentation is used, often a lifecycle phase is used to point out a certain target group.

Psychographic segmentation is based on not easy to measure characteristics of the consumer, such as lifestyle.

Behavioural segmentation is based on how the customer reacts on branding, price differences, differences in usage of a product etc. See PhD study ‘product personality’ by Pascalle Govers, Industrial Design Engineering, 2004 [7].

4.4 Demographic segmentation by the Dutch Ministry of VROM

The booklet of VROM titled Between Student House and Service flat; the Dutch on Housing (in Dutch: Tussen studentenhuis en serviceflat, Nederlanders over wonen)[8] distinguishes 5 life phases: The starter has been defined as a household
of 18-24 years. More than 73% of these households are single person households. The group of persons in their twenties and thirties are defined as households of 25 up to 39 years. In this category single person households are just as many as two person households and more person households. In the category of 40-54 years more than half of the households form a family with children. In the next group, between 55 and the 74 years, the children left the house the number of two person households is the biggest market share. In the last category, 75 and older, 62% of the group is alone again.

In the book statements are collected of occupants and their will to move. Especially the neighbourhood is a very important factor in the reason for moving or not. As long as the neighbourhood satisfies and the people who live there have the same lifestyle, keep the streets clean and greet each other, people are less inclined to move.

Fig. 7. Between Student House and Service flat; the Dutch on Housing [8]
4.5 Psychographic segmentation: Lifestyles

An alternative for market research can be that we devise for one or more constituents. (Cuperus, 1999 [9]).

For example: “a rich family with a golden retriever”, “a couple working couple who generally eats healthy”, “a couple in their sixties in the city who are frequently visited by their children”. These model clients will be described by lifestyle. A combination of client/lifestyles contains a good largest divider of what we want, being appropriate within the called restrictions. These choices could function as first anchors to get a response from the market, after which the product/market relation is improved and optimised.

Fig. 8. Lifestyles: students according to IKEA
5 Concept House

5.1 Considerations Marketing Concept House

As already has been stated in the "Start Report Concept House, May 2004"[1] Concept House will prepare the Western European market for industrialized housing. The idea is that with industrialization and mass customisation Concept House can build more customized and more flexible houses. But for a good industrialization process, at least 5,000 house units per year should be produced. This article will deal with the question where these 5,000 houses could be sold and to whom they will be sold. The market share involved in this amount of houses depends on the area that will be chosen. 5,000 Houses per year is a market share of 3% of the total potential of newly build houses in the Netherlands per year. The year production of houses in Western Europe is 1,750,000, so 5,000 units would be only a market share of 0.3%.

The first concepts will be made for the Dutch housing market, but target groups will be chosen in such a way that they are easy to imply on the Western European market as well. Looking to the totality of the (Dutch) housing market gives completely different target groups than looking only to the potential market share of newly build houses. But nevertheless it would be very interesting to reach the groups that normally would have chosen a house in the existing housing stock.

At first we will focus mainly on the Dutch housing market in order to leave out the difficulties with national legislations and other is an important regional and national obstacle. However, it would be good to think about the most important differences when extending Concept House from the Dutch to the Western European market. The different demands of the other countries, might influence the concept and therefore also the production line and the investments will change. This might affect the appearance of the Concept Houses as well.

It is wise to choose the higher segment (rich and wealthy) for the first series of Concept Houses. A cheap image can never be improved anymore. In the shipbuilding industry customized Seri products are widely accepted by the rich people as well. A tailor-made job much would be much more expensive and the customized seriesproducts are already of high quality and aimed at a rich target group.

Thus also the Concept House is able to aim at a higher segment with choice options; 'economic but not cheap'. Lifestyle definitions can be used for this. The aim is not a certain demographic group on age or income, but to give a grip at developing for an economic rich target group.

5.2 Leading to a Proposal for 5 Dutch Target Groups

Having gone through the previous considerations, we want to propose five target groups for the development of Concept Houses. These are the groups that have the biggest potential market share and will bring us the most interesting Concept Houses.

Three groups are based on demographic characteristics, the two other are based on psychographic characteristics. Behavioural segmentation is not applicable to the housing market because the building industry has no history of market research. Data concerning branding etc. in housing are entirely not present. The geographic segmentation might become interesting later in the process when we extend our market to Western Europe.
5.3 Five Chosen Target Groups for Concept House

**Group 1: Students**

This group is a demographic group. Common factors in this group are age, education and a low income. Because of this lower income, students are less autonomous to even think of adapting a specific brand. A student will probably prefer a cheaper dwelling than a dwelling of a famous brand.

Students mainly live in university cities, although also on the Dutch HBO level an increasing percentage independent living students need a place to live on their own. The numbers of students in the Netherlands only is not high enough to reach an acceptable market share, also because there are already solutions on the market. [ref bouwen met staal].

![Example of student houses in Delft](Photo: Ronald Visser)

**The marketing mix:**

The status of a dwelling is determined by the price the student can afford for his monthly rent. The dwellings will be sold to student housing corporations.

The product student house consists of units that can be rented separately. With a private bath, toilet and kitchen, the rent can be higher. But the student culture in the Netherlands has a history of shared facilities and common living rooms for better social coherence.
The promotion strategy of selling student houses, will be addressed to housing corporations that already have student houses available and to the universities who will probably provide the space to build the houses on their campus.

The place: mainly in university cities. There are 13 universities in the Netherlands. There are universities all over Western Europe.

**Group 2: Starters**

According to "Tussen Studentenhuis en Serviceflat" [8] a starter is defined as a household of 18-24 years, which for the first time on itself inhabit a house as a main inhabitant. More than 73% of these households are single person households. According to this definition it is therefore a clearly assignable demographic group. The group has resemblances in age and family composition.

The market share for this group in the Netherlands is rather large. On the current market there is almost no offer for this group. Currently starters occupy social hiring houses, too cheap for them, or private hiring houses, too expensive and too small for them. Former students often continue to live in cheap student rooms and constipate the healthy flow in the market by doing so. On all sides in the Dutch housing market occupants continue to live in too cheap houses and as a result the flow is locked.

![Fig 10. Example of starters (Harbourview Penthouse)](image)

The product that we can develop for this group is an affordable house to live in for five years. The market flow can be stimulated with for example tax-advantages. The
product must have all facilities for itself. The house must be arranged near the town centre, but not on such a wanted place that everyone wants continuing live there after five years. The flow must be promoted. Another possibility is to built houses on empty spots in or close the city centre.

**Group 3: Serviced Elderly**

According to the book ""Tussen Studentenhuis en Serviceflat" [8] another demographic category is 75 years of age and older. 62% of this group lives alone. They usually have a traditional taste, which does not accord to our design ideas. But from a social point of view this group is rather interesting, also because of the interesting domotica appliances that could be incorporated in the design.

This group can be easily identified by age. But this potential target group does not have to be limited to the elderly. Psychiatric patients can also be included in this group. These are people who often want to live independently, but do need occasional additional care. The housing complex should be placed on the area belonging to the care giving institution (for the elderly we should think of the terrain of a nursing home). The houses must be equipped with kitchen, toilet and shower accessible to handicapped people and day-care: geometry, lowering thresholds, electronic equipment etc.). Price is less of a problem than for the other target groups. Quality of living is priority.

![Fig. 11. Use of domotics in the care of the elderly (Photomontage based on [8])]
Group 4 Young Urban Residents

Instead of a demographic target group, also lifestyle groups are a possibility to design for. For example the group of people that wants to live near the city centre, or another important facility as a railway station or sport facilities. They can be housed in an apartment building were different household sizes can fit in because of the flexibility of floor plan arrangement.

The construction could be for rent by a housing corporation, while the infill can have different types of renting or selling and all that is in between.

The representation of the building depends on the neighbourhood. The most interesting locations are the locations just outside the city centre. In Rotterdam one could imagine the current dock quays.

Fig. 12. Young urban residents: Photomontage of Richard Horden's Tree Tower Project in the centre of The Hague (photomontage by Ronald Visser)
Group 5: Detached House Owners

Another interesting group is the individual dweller in a freestanding house. Detached houses on own ground are the target group of most of the catalogue house suppliers. This is the ideal for the average Dutch family, but ground for building houses is not freely available. An interesting product for this group can be a lightweight house for a certain time on a certain spot. And after a while the house must have the possibility to put somewhere else to keep the flow in the house market and to guarantee the sustainability of the Dutch landscape. Therefore the price of the building ground is less important.

The houses can be made for either one or more persons. Industrialisation guarantees that they are easily adaptable. Within this topic several lifestyles can be a target group. Here the high approach on the market, possibly with branding, is very important. Afterwards a cheaper alternative can be put on the market, which will offer the same for less money.

An interesting product for this group might be living on the water. Also for this purpose a lightweight construction would be appropriate. Especially in the Netherlands there is a large potential market because of the large amount of water. For more information on this subject, see the article *Towards a Floating Concept House?* by Ties Rijcken, elsewhere in this syllabus.

![Fig. 13. The best foundation for 'detached house owners' might be a floating one](photograph: Attika Architecten)

A second product group for this target group might be mobile homes. Those can hardly be called real estate anymore, because of their high degree of mobility. The extremes of Andreas Vogler and Richard Horden could be the a summit within this group.
A tirth sub-group would be lightweight toppings on existing buildings as Erik Vreedenburg is designing and realising. The identification of the different sub-groups will be done in the coming month. These subgroups will be the basics for design work by ourselves and by students.

![Building on top of the 'Zwarte Madonna' (Black Madonna) by Archipel Ontwerpers, Eric Vreedenburgh](from www.archipelontwerpes.nl)

Fig. 14. Building on top of the 'Zwarte Madonna' (Black Madonna) by Archipel Ontwerpers, Eric Vreedenburgh (from www.archipelontwerpes.nl)

5. Conclusion
The result of the considerations in this preliminary marketing is the description of five distinct target groups in the market of new housing.

- Students
- Starters
- Serviced Elderly
- Young Urban Residents
- Detached House Owners.

The questions for the future are:

- What are the basic needs of the consumer within the chosen target groups.
- What product characteristics can we derive from these basic needs?
• What are our design assignments, other than those basic needs? Do we want to reach a high-tech image, or rigid and business-like? Do we have totally freedom of material and production?

If we know what we want, this will not be affected anymore by any other argument about lifestyle or target group. These preferences must be clear in advance. It might be possible to obtain important economic or comfort advantages out of these preferences. And from that moment the preference become our constraints, which will make the design process simpler. Choices that are made do not influence the scientific level; it is possible to repeat our method with other preferences.

So with these five groups, we can start designing house designs in an urban environment, and simultaneously developing the most appropriate industrially produced components, elements and materials.

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Conclusions for the Future

Mick Eekhout

In June 2002, 65 year old contractor Harry Oude Vrielink asked me to form a group on the TU Delft that would design and develop a new type of house, preferably without any of the traditional materials. He had seen enough of tradition. It took 2 years of continuous talking and meeting and writing, before I took on the job of forming the group. Of course the prime preference was to complete the running research groups like the Zappi Dome group, the Blob group, the 'Maison d'Artiste' group. They all had to be completed either with the building of a real prototype or with a publication of considerable quality. There was an official research assessment at the faculty of Architecture, which required much effort, but our research group Blobs received the highest scores. On the wings of success we continued expanding the research ambitions and support in the form of a sponsoring consortium. Only after 2 years I had space in my head to really make a plan. The plan was to design a bomb in the housing world. Two graduates, Ernst Haagsman and Kay Verkaik, helped with the starting report and on the basis of that we could convince the first sponsors to join in and to finance the first PhD student Sannie Verweij, who started 1 September 2004. On 1 April 2005 Ties Rijcken started. The amount of interested, involved and associated researchers grew to 8, supervised and debated by 4 full and associate professors. After around 9 months we organized the first Concept House symposium. All planning intentions are realized.

The remainder of this academic year will be used by making plans for the entire coming year. Dr. Wim Poelman, the new associate professor of the Chair of Product Development, will join the group, do the daily supervision and start scouting the field of 'Domotics'. The candidacy of a PhD student for Marketing of Concept House is being prepared. Jan Timmers PhD student of Jos Lichtenberg will take up the item of architecture and urban design applications of Concept House. In the meantime Erik Vreedenburg is expanding his airborne top-apartments with a scientific dissertation, as does Martin Smit on the methodology of incremental quality improvements in repeating design assignments. The detailed plan for the second Concept House year (academic year 2005/2006) will be drafted within the coming month. It will be distributed for information and comment of the sponsors before the summer holidays to complete the round of the first Concept house year. Hopefully the consortium of sponsors will also grow as to allow us to take more PhD students on board.

While preparing this symposium book in 4 weeks time, the large variety of the contributions we invited for this symposium slowly became apparent. Contributions covered both the dreaming (Mick Eekhout, Alex Sievers) and designing side (Richard Horden, Andreas Vogler, Ties Rijcken) as well as the performing, realizing side. But also the market of Concept House (Henk Westra, Han Michel), the marketing (Joop Halman) and the definition of the most promising market target groups (Sannie Verweij) are brought in this book forward for discussion. And the philosophy of the design principles which are extremely important to guide the proper route is described (Age van Randen, Ype Cuperus and Bernard Leupen).
I would also like to use this conclusion to express my gratitude to Ronald Visser. Thanks to a tremendous effort this book was effectively made in an ultra-short time.

The invitation to this 'scientific eleven' to make a contribution to a symposium which had to be described in the form of an article, came as a shock at first for all eleven, but gradually, while writing and editing, the quality was raised to a level no one had dreamed about before. And all of that in 4 weeks time! All of the contributions sparkle enough to enter into discussion to enjoy the debate and start with the next phase of analysis and synthesis, of philosophy and design, with more vigour, humour and wit. Each of the contributions is only covering a tip of the iceberg below. It is up to the individual contributors to expand their findings in more depth or to use these as basics for education of students. We would like to arrange the relationship between Research on Concept House (which in fact will be a smart academic mix of Design, Development & Research) with actual market so that in a few years we could compose local applications of Concept House in different urban contexts realized one or two of them in the natural flow of events of this research program. Seen the complexity of the problem and the necessity of different specialties a multi-disciplinary approach in the research group is inevitable. I can mention 14 distinct different playing fields that are intertwined in the research item of Concept House, that need different research participations players in one way or another:

- Social and Economical Politics,
- Real Estate Housing,
- Marketing,
- Urban Design,
- Architecture,
- Building Technology,
- Production Technology
- Material Technology,
- Industrial Design
- Installation Design
- Domotics,
- Behavioural studies,
- Entrepreneurial management,
- Economics.

The consequence of which is that the societal problem of economic housing for different target groups can only be dealt with by a conglomerate of different specialisms, which we all want to cover in a restricted or an extensive manner. We will develop the group into a multi-disciplinary research approach to enlarge the chances of realizing real prototypes and even zero series of productions with many application designs in urban or landscape contexts. Concept Houses could evolve from that point in very different design styles, consumer life styles and build for a little more than short term problems in society.

[Signature]

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In the last three decades Dutch housing has evolved from a rationalized on-site industry to an entangled combination of industrial pre-fabrication and on-site industry. The current building industry needs to shift radically to industrialization in order to revitalize the product "dwelling" to match current and future standards. Large industrialization supplies our society with high quality industrial domestic products for small prices. The increasing individualization of the consumer on the other hand caused a change in consumer orientated products, including real estate products like housing. Our research aims at a radical progress in the field of customized industrial housing where the emphasis lies on the 'individualization of industrialization'. The industrial dwelling has to free itself from the restrictions of real estate like building licenses and mortgages, which determined housing projects the last decade on top of the problem of restricted land ownership for project development.

As a technical product the dwelling will form a dialogue between ambitions on the one hand and construction materials on the other hand, which will be selected and optimized according to their functions, abilities and properties. This is in high contrast to the traditional way of building present in the current building industry.

Concept House is a research group initiated from the Chair of Product Development at the faculty of Architecture, that also encompasses the same Chair at the TU Eindhoven and the Chair of Innovation Processes at the University of Twente. The goal of the research is to analyze the market possibilities, to design and develop new concept houses in a consumer-directed industrialized production method, to build and test prototypes and even to prepare for the zero series of production. The duration of the research is from September 2004 to December 2009. Each year the research group organizes a public symposium. This first one was on June 22nd 2005.

Our ambition is to develop a non-reversible strategy for a totally new generation of industrial dwellings. To provide a viable and distinguished alternative for the current housing developments to be reached by attracting new players (from the industry) and using new materials and techniques, making a highly consumer aimed environment possible.