

Sustainable Housing Quality

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The section Sustainable Housing Quality is part of the OTB Research for the Built Environment Department. The research belongs to the Research programme **Housing in a changing society**. And falls under the chair Housing Quality and Process Innovation of Prof. dr. Henk Visscher.

The research in the section concentrates on the following key topics:

Organisational strategies

Key words: Asset Management, Partnering Relationships, Corporate Governance

Key topics

1. Strategies of social housing providers
2. Innovation in housing renovation and maintenance processes

Quality

Keywords: Energy Efficient Housing, Sustainable and Healthy Housing, Building Regulations

Key topics

1. Assessment of energy efficiency, environmental impact and indoor air quality
2. Evaluation of policy instruments and enforcement procedures

PhD candidates with own research funding are invited to submit proposals that relate to the following Topics:

Organisational strategies: *Innovation in housing renovation and maintenance processes*

1. Demand and Supply of Housing Renovation in a Circular Economy

All around the world the theory of the Circular Economy is accepted with open arms by public and private stakeholders to overcome emerging environmental problems. In a Circular Economy waste is being designed out of production processes by changing the linear consumption pattern to one where consumption is based on circular movements, thereby replacing the end of life of products by re-use. Theoretically suppliers keep the ownership of buildings and/or building products offering product-service systems, while clients demand for specific special and technical performances during a specified period.

Research questions are what conditions and incentives encourage and stimulate (social) landlords to enter the CE and how contractors and building product suppliers can operate successfully in the housing renovation market of the future by developing new collaborative business models.

More information: Dr. Ad Straub, a.straub@tudelft.nl

2. Demand and Supply-side perspectives of Deep Renovation

Deep renovation of the residential housing stock, and especially the need for highly improved energy efficiency, tend to push the limits of the demand and supply-side economics. Demand- and supply-side has to adopt innovative project delivery methods based upon the principles of performance-based contracting, whole-life costing and supply-chain integration. The supply-side has to change from awaiting tenders for renovation projects into a market offering innovative performance-based

(one-off) renovation products for diverse dwelling types. Making use of mass prefabrication, it is expected that the renovation product costs will lower considerably. Besides adopting product and process innovations, suppliers have to develop new complementary services based upon principles of service-life planning and whole-life costing.

Research questions are what conditions and incentives encourage and stimulate (social) landlords to adopt integrated project delivery methods and to create a market for nearly zero-energy renovations, and what are the effects of partnering relationships on whole-life costs and (energy) performances? What conditions and incentives encourage and stimulate market players to adopt successful innovations and lower renovation product costs?

More information: Dr. Ad Straub, a.straub@tudelft.nl

3. Energy-flexible buildings

In the near future it is expected that buildings and neighbourhoods will be nearly zero-energy or energy-producing. It is important to trace the experiences of companies, users and policy-makers to initiate and develop the market for these buildings. Amongst other, the indoor climate, the end-user experiences and the energy use in such buildings should be investigated and a proper understanding is needed how such buildings should interact with future smart heat and electricity grids. It is important to investigate what sustainable technologies, concepts, businesses and policies can be successfully implemented, and to understand how systemic innovation is emerging from crossing experiences from various disciplines and from collaboration in networks and building teams to realise and/or maintain energy flexible buildings and neighbourhoods.

Research questions are what innovations are successfully being implemented in various countries and how could the business models and energy, innovation and quality assurance policy for energy flexible buildings be further developed?

More information: Dr. Erwin Mlecnik, e.mlecnik@tudelft.nl

4. Customer Journeys to Deep Renovation

Clearly, the customer journey in the owner-occupied sector to deep renovation is long and facing obstacles of distrust in supply-side actors, budgetary constraints and quality assurance issues. Homeowners prefer to contact small and medium sized enterprises (SMEs) when renovating or planning to renovate their houses and want to take small steps. Contractors have to change their routinized behaviour and should approach the homeowner in a novel way and should collaborate with enterprises that sell the renovation to the customers.

Research questions are how to model customer journeys in one-off renovation and stepwise renovation processes and how to model related transaction costs.

More information: Dr. Ad Straub, a.straub@tudelft.nl

Quality: Assessment of energy efficiency, environmental impact and indoor air quality

5. Small & Smart Data for Energy Technology & Policy Assessment in Buildings

Severe differences between predicted and actual energy savings were demonstrated recently. It is believed that the causes for these discrepancies lie in the combination of large uncertainties in occupant behaviour, physical dwelling characteristics and performance of installations for heating and ventilation. The expected increasing availability of datasets at building stock level poses the

question how to use them to improve or create new building models for energy assessment. Large data sets at the level of building stock should be enriched with monitoring and small data, or vice-versa, to create new knowledge on parameter interaction at different levels and to therefore improve prediction models.

Research questions are how comfort perception relates to the buildings' physical characteristics and impinges patterns of use and energy use, and how a new theoretical framework for the enrichment of large data sets with small data could be developed and tested.

More information: Laure Itard, l.c.m.itard@tudelft.nl

6. Service Lives of Buildings and Building Components and Life Cycle Assessment

Life cycle assessment (LCA) is a powerful tool to assess the environmental performance of buildings and building components. With this method, a broad range of environmental impacts of buildings and building components are assessed over their whole life cycle, from mining of raw materials via the construction and use phase, to the waste treatment. An important parameter in LCA is the service life of the product that is being assessed. Building components have considerably longer service lives than most products assessed in LCA, so the service lives have a big impact on the environmental performance of buildings. Robust values are needed for the service lives of building components to have an accurate estimation of the environmental impacts.

There are several service life database and methodologies available in the Netherlands, the UK, Italy, France, the Scandinavian countries and Japan. The compatibility of these databases and methodologies with LCA needs to be assessed, and an up-to-date list of default service life values for different building components needs to be composed with consensus in the building industry. The relative impact of the service life of different building components on the LCA results can be calculated to determine the components with the highest influence and thus most urgently need robust service life values. The Dutch harmonized LCA calculation method for new buildings can be used as starting point, but other building LCA tools such as BREAAAM, LEED, BEES and ATHENA can also be considered for application of the service lives assessed in this research

More information: Arjen Meijer, a.meijer@tudelft.nl

Quality: Evaluation of policy instruments and enforcement procedures

7. Local networks for an energy-efficient housing stock

Local, bottom-up initiatives, intended to make the existing housing stock more energy-efficient, have emerged in several Western countries. Examples of these initiatives are consortiums of local companies in the building or installation sector, community groups and energy cooperation's. In an era of government retrenchment and public budget savings, such initiatives are mostly embraced by governments as an additional means to attain their policy goals and to realise their ambitions. There are indications that the number of these initiatives increased dramatically in the last years, but an estimation of the exact number is lacking, and little is known about their effectiveness. We expect big differences between the initiatives as for the size of the network, the nature of the parties involved, the formal and actual goals, and the stage of development. This raises the question, to which extent the success (or failure) of an initiative can be attributed to these variables.

Research questions focus on the relationship between, on the one hand, characteristics of a bottom-up, private network for improving the energy efficiency of a certain housing stock or the development of such a network and, on the other hand, the results of such a network in terms of energy investments and the actual improvement of the energy efficiency of that housing stock.

More information: Nico Nieboer, n.e.t.nieboer@tudelft.nl

8. Effectiveness of governmental energy-efficiency incentive programs

In many countries the owner-occupied sector forms a considerable share of the total housing market. Many studies to date suggest that this sector is not very willing to adopt energy efficiency measures. Governments in various countries have implemented programs to stimulate homeowners to improve the energy performance of their properties. This stimulation can take different forms, such as advice, subsidisation and backed loans. It is known that initiatives in this field are numerous, but knowledge about these initiatives is fragmented and their effectiveness is largely unknown.

Research questions deal with the effectiveness of governmental energy-efficiency incentive programs and the reasons for their success or failure.

More information: Nico Nieboer, n.e.t.nieboer@tudelft.nl

9. Local government interventions in the physical quality

Worldwide local authorities look at the private owned housing stock because it has an enormous potential for realizing energy saving goals. They also observe that the physical quality of parts of the older private owned stock is far from satisfying and partly seriously substandard. This poor quality can be related to various constraints owners are confronted with in practice, e.g. lack of financial means or insufficient knowledge. Because the quality of owner-occupied housing exceeds the individual interest, local authorities also take general concerns into consideration like the negative effects that seriously substandard private owned dwellings can have on the surrounding neighbourhoods. Local governments are coping with the question if and (if yes) how they can kill these maintenance backlogs and energy improvement with one stone.

Research questions deal with the effectiveness and efficiency of local policy instruments and the roles of public and private stakeholders, in order to tackle the quality problems and energy saving goals, in the private sector.

More information: Frits Meijer, f.m.meijer@tudelft.nl

10. Towards effective and efficient quality control systems for housing

A well-functioning building control regulatory system is being considered by the World Bank as an important component of a modern society. During the last decades building control tasks have - to an increasing extent - been privatized in most European countries. For a large part this development can be related to the general deregulation policies of governments. Although the pace of these developments varies between the European countries some converging trends are recognizable. Besides the shift in responsibilities for public to private parties, we can see a reformulation of technical demands in performance based demands, an increase of building works that are exempt from control and the reduction of building permit procedure times.

The main research question is what are the ingredients for an effective and efficient quality control system for buildings? Sub questions that are relevant are: What quality aspects should be regulated to guarantee a minimal quality? What are the minimum demands and how should they be formulated? What could be the roles and responsibilities of public and private parties in safeguarding this (minimum) quality?

More information: Frits Meijer, f.m.meijer@tudelft.nl