De-burden or co-design & co-create?

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\textbf{PAPER ABSTRACT} Until recently the development of new housing projects or complex retrofitting projects were tasks for professionals. Nowadays more and more people are eager to actively influence and shape their own environment, either by choosing from what is on offer by professionals, where mass-customization has led to substantial choice, or by doing things themselves, taking on the role as initiator, (co-)developer, (co-) designer and/or (co-)creator. There are also people who organize themselves to acquire means to generate renewable energy or reduce energy consumption in their neighbourhood or village. The number of local initiatives is currently growing exponentially, while on the other hand, similar initiatives are started by national government, municipalities and housing corporations in order to realize policy goals. These developments force professionals in construction, both in private companies and self-employed, to rethink their role and the way they wish to do business.

The article will describe two different case studies that deal with these two trends in the construction industry which will be referred to as: (1) de-burdening and (2) co-creation and co-production. These case studies are used to increase understanding of the requirements of tenants and owner-occupants. The paper will reflect on the consequences for professionals in construction. The projects described are recent projects in the Netherlands. Both were part of the Energy Leap (Energiesprong) an innovation programme commissioned by the Dutch Ministry of the Interior.

\textbf{KEYWORDS:} energy efficiency, retrofitting of housing, de-burden, co-design, co-create, Energiesprong

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Practical context - Energiesprong (Energy Leap)

Until recently the development of new housing projects or complex retrofittings were tasks for professionals. Nowadays lots of people are eager to actively influence and shape their own environment. This is done, either by choosing from what is on offer by professionals where mass-customization has led to substantial choice, or by doing things themselves taking on the role as initiator, (co-)developer, (co-)designer and/or (co-)creator. There are also people who organize themselves to acquire means to generate renewable energy or reduce energy consumption in their neighbourhood or village. The number of local initiatives is currently growing exponentially. These developments force professionals in construction, both in private companies and self-employed, to rethink their roles and the way they wish to do business.

This paper will describe two different case studies dealing with these two trends which will be referred to as: (1) de-burdening and (2) co-creation and co-production. These case studies are used to increase understanding of the requirements of tenants and owner-occupants. The projects described are recent Dutch projects, both part of Energy Leap (Energiesprong), an innovation programme commissioned by the Dutch Ministry of the Interior and operated by Platform 31. The programme ran until the end of 2014, although parts were later extended to the end of 2015. The aim is to make various buildings energy-neutral and to boost large-scale initiatives. The sub-programmes are targeted at homes owned by housing associations, privately owned homes, office buildings, shops, and care institutions. The programme is not about driving technical innovation, it is about ensuring new supply by encouraging companies to provide a variety of technical sub-solutions as a full-service package that also includes financing options and about asking clients to put out tenders and ask for quotes in a novel way, with the government doing its bit by making changes to the rules and regulations.

With a Dutch housing stock of seven million, where most social housing is relatively old with about 50% built between 1950 – 1970, there is great potential for energy savings. The building quality of these houses may be tolerable, but thermal insulation is poor. The sub-programmes for the residential housing market include De Stroomversnelling (Rapids), Lokaal alle lichten op groen (Locally All Lights on Green (LALOG)), and the Ons huis verdient het (Our home deserves it) campaign and TV show. This campaign, launched early 2014, was designed to show banks and building companies that many owner-occupants are interested in converting their homes to net zero homes. The accompanying TV show was aired in mid-April 2014. Two projects of two sub-programmes, Rapids Rental and LALOG, are used as case studies to compare different approaches and their consequences for the role of professionals in construction.

The first sub-programme is officially called “Deal Stroomversnelling voor huurwoningen”, and is a deal with housing associations and building companies regarding the acceleration of deep retrofitting of rental housing. We will refer to it as Rapids Rental. As a result of the financial crisis, the financial position of housing associations does not allow for huge investments. The key objective for Rapids Rental is to affordably renovate 111,000 rental houses block by block to “zero-on-the-meter” before the year 2020. To achieve this objective, four major construction companies (Volker Wessels, Dura Vermeer, Ballast Nedam and BAM) have been invited by six housing associations to develop and demonstrate their solutions for this challenge. The idea is that the renovation methods can be scaled up gradually to industrial production levels by employing prefabricated building components, as was done during the building of most estates. Parallel to the technical challenge, important changes in legislation and regulation are made in order to solve the problem of split incentive for social housing associations as owner of the renovated houses. In this paper we will focus on the experiences in the Schrijverswijk in Heerhugowaard.

In the second sub-programme it are the owner-occupants themselves who are seeking to make their homes energy-neutral. The LALOG sub-programme provided support to groups of owners in six municipalities who want to do just that: Apeldoorn, Wageningen, Den Bosch, Hoorn, Amsterdam and Amersfoort. Goal was to bring at least 20 homes in each of these municipalities to energy neutral. It was a process of learning by doing by residents, builders, municipal officers, contractors, brokers, appraisers and bankers. In this paper we will focus on the experiences of the Energy Expedition in Apeldoorn, also known as #ENEXAP.
Purpose and methodology

In this paper the consequences of current developments for professionals involved in the retrofitting of houses will be discussed based on the experiences in two case studies. For the Rapids case in Heerhugowaard the neighbourhood was visited on April 7, 2015 (Oostra, 2015b). Both the planner of the contractor and a representative of the housing cooperation were present to give an introduction. More information came from meetings with Energy Leap, Rapids meetings, conversations related to Rapids and from the Internet data made available by Energy Leap (Energiesprong, 2015), Rapids (Stroomversnelling, 2013), the housing association (Woonwaard, 2015) and BAM (BAM, 2014a, b, c, d).

The #ENEXAP case is based on my experience as member of the board from #ENEXAP from November 2013 until April 2015. During this period various projects were undertaken to facilitate owner-occupants to make their specific desires and needs explicit, to analyze the situation in their own house and gather information that would be necessary to include professionals, to form consortia of companies and train them to make them fit for the job etc. The material on which the analysis is based derives from action research, board meetings, occupant meetings, meetings with Energy Leap, study meetings for the companies and conversations with people related to #ENEXAP.

First a theoretical framework will be presented, followed by the description of the two case studies. The next section will be dedicated to the analysis of the two cases before ending with the concluding section.

Theoretical context

As a result of individualization more and more people are eager to make their own decisions. Individualization is a trend that began in the 1960s and is still continuing today. According to Zygmunt Bauman (2000) a shift has been made in modern society in the latter half of the 20th century: from being a society of producers we changed into a society of consumers. In the process we have become used to being addressed as individuals and as consumers, rather than as members of a group. What counted before was the family you were part of, the church community that you were a member of, or the village where you grew up in. Now, we are regarded as independent individuals, entitled to make our own choices. Do-it-yourself was linked to make your own choices from what is already available. Sociologists narrate in this regard of the obligation of each individual to construct their own life, or, to write their own do-it-yourself biography, as Roland Hitzler (1988) put it. From that perspective, it is legitimate for us to take control of our own environment, for example by actively determining how and where we want to live and work, not leaving this for others to decide. People expect and demand more influence as a result of this increasing individualism (Bang & Sørensen 1999). It is therefore logical for people to take control over their own community and environment. As a consequence people are also interested in taking control of their own energy supply, investing in insulation and solar panels, even organizing themselves around this common interest purchasing and applying energy measures collectively, or rolling out their own fiber optic network because local providers are not interested in making the effort, since they do not believe there is a business case. An increasing number of citizens are launching local initiatives to improve their community and environment (Oostra & Jablonska 2013).

As stated before, the form in which people actively influence and shape their own environment in the domain of housing is done either by exploiting the choice created by professionals using principles from Open Building and mass customization, or by taking on the role as initiator, or even the role of (co-)developer, (co-)designer and/or (co-)creator. First a short overview of the state-of-the-art of these two developments is given.

Open Building and mass-customization

The housing market has changed significantly in recent decades. The housing shortage in Europe after World War II led to an extremely high demand for housing. To meet this demand, production was scaled up through rationalization and industrialization. This resulted in mass housing projects, which are characterized by a high degree of uniformity. Everywhere in Europe examples of those postwar expansion areas can be found. Because of high demands, intensified by the diminishing of the average household size, the industry took on a supply driven market focus. Offering parties basically determined what the market needed, and what was
offered was sold. This supply-driven market now largely turns into a buyer's market, accelerated due to the consequences of the financial crisis. Individualization has also made people become more assertive. They increasingly expect that, like many other products, homes can be made according to their specific needs and requirements.

Ideas and techniques that make it possible to respond to individual requirements and desires are not new. In 1932 Le Corbusier drew his plan Obus for Algiers. This plan consisted of a mega-bearing structure in which, as a matter of speech, individual and unique houses were inserted. This plan was never realized, but the plan of Le Corbusier L'Unité d'Habitation in Marseille, designed on the same principle, was. It took until the 60s, until the end of the mass housing was announced by John Habraken (Habraken, 1961). Habraken developed his ideas further with the SAR research at TU Eindhoven in the Netherlands under the name Open Building. They developed a support and infill structure, in which it was possible for various stakeholders, including occupants, to develop their own knowledge, expertise and preferences. These ideas were picked up and applied worldwide, for instance in Japan, Finland, USA, and also in unexpected countries like Russia and South Africa. Habraken continued his developments from MIT. Since the '90s these ideas were mixed with principles and techniques from lean and mass customization (Kazi e.a. 2007).

Industrialization coupled with ICT and supply chain integration opens up the possibility of providing end-users with greater quality and more transparent choices using a top-down approach. This is done by taking a rational approach to construction and offering prefab solutions that can be applied in several combinations, mass-customization. Components are manufactured under controlled conditions, instead of being produced in adverse weather conditions at the construction site. This leads to better quality products. Platform-based buildings allow parts of buildings that end-users and clients have no need to influence to be standardized, which is also done in the car industry (Halman, 2004). After all, why would you, as a client, want to be bothered by the building’s foundation or the wiring and plumbing? By providing options that matter, building companies can give clients a tailor-made choice. Although this choice is limited in scope, the process is made more transparent for the client because the options are explained as well as how they impact budget, energy consumption or the maintenance bill. Depending on requirements and budget, the client is free to weigh up the pros and cons and choose between the alternatives on offer.

Building companies and architects have used the possibilities offered by Open Building and mass-customization to supply end-users with better quality products and greater transparency in terms of choice (Oostra et al., 2007; Engström et al., 2007). A lot has happened in mass customization in the past few years. Catalogue homes have become a well-known phenomenon and many building companies are focusing on supply chain integration and mass-customization. Famous examples in the Netherlands include the Van Dijk Group’s Customised Housing designs and Nijhuis’ Trento concept. Abroad there are other interesting developments for example NCC in Sweden (high-tech mass customization combined with indoor building site), Sekisui in Japan (home-buying marketed as a total experience), and Bensonwood Homes in the US (passive house solutions based on Open Building principles).

The ideas of Open Building are still developed further, even today. Configurators allow future residents to make up their own property. This is made possible by technology, the developments in the fields of lean, mass-customization and IT in particular. Recently, initiatives emerging around the adaptation of buildings and homes go even further. The development of tools accessible via Internet, facilitate people in composing the set-up of their own home. These platforms can at the same time assemble the outcomes of a group of candidates in order to plan the transformation of existing buildings (Pool, 2013). Other projects start from a more individual architect-to-client basis. These kinds of projects are in fact a variation on the principle of support and infill, as proposed by Habraken. The Tetterode complex in Amsterdam was in fact the first of its kind, followed by the Solids, which have been realized in 2011 (Platform31, 2013). The current developments in IT and manufacturing will allow users to take a more active role in the design and production process. The challenge now is to search for various possible scenarios for the transformation of existing buildings in which the right balance between the ultimate freedom for the end-user is combined with the observance of the conditions and limitations of the particular object being transformed and its effects on the environment. What does this mean for construction? How will it influence the role of the architect? And what will happen with the roles of other professionals in construction?
Co-creation and co-production of individuals and local initiatives

The potential of emerging local energy initiatives is crucial to realize policy goals (Hielscher, 2011; Thøgersen, 2005). In the government model, the role of citizens was limited to test policy and co-produce policy at special determined moments during procedures. However, in recent governance processes, the openness in policy formulating has increased considerably and citizens are able to be involved in the processes as an equal actor (Bogason & Musso, 2006). The local energy initiatives can be seen as an important first step in active citizenship and is promoted as a solution to shrinking public budgets (Hajer, 2011), signaling society being changed under the influence of individualization and digitalization (Castells, 1996). The reasons for people to start local initiatives can be various (Oostra & Jablonska, 2013):

- concern about energy prices or exploitation costs of their dwellings in the future
- to improve quality of living in their community
- to improve social cohesion (especially in areas with declining population)
- the desire to do something together
- as a means to jointly save energy
- to gain control over their own energy supply
- concern about the environment
- dissatisfaction with large energy companies
- and to gain purchase power and improve efficiency of energy supply by organizing as a group.

It is not the first time in history that citizens' initiatives are leading to societal transformations and the formation of new institutions and local enterprises (Bruheze & Oldenziel, 2013). With the invention of steam and diesel engines, combined with the rise of capitalism and tayloristic1 organizational principles the structure of our society changed completely (Freeman, 1997; Arthur, 2002; Arthur, 2013). In the last century we built up our current society as a centralized structure in which units are organized top-down and mono-disciplinary as Taylor (1911) prescribed. According to Castells (1996) our society is now moving in the opposite direction, thanks to developments in IT: decentralization of large vertical organizations made of flexible networks consisting of small, multi-disciplinary units. In these units, changeable individuals, companies and businesses operate. They can adapt to changing circumstances. It is expected that innovative locally oriented energy systems, such as smart micro-grids and energy storage systems, promote such a development even further (Nykamp 2013). Rifkin (2011) frames these developments as the third industrial revolution.

In this paper we will focus on a local energy initiative that is focused on the transformation of houses to energy neutral. If the development and use of local energy systems is considered from a Transition Theory perspective (Geels and Kemp, 2007) we see that local energy initiatives develop and manage a key niche. Several success factors of local energy initiatives are identified and described in literature: strong local ties, cooperation between local energy initiatives and developers of technology from (local) SMEs, and structural and long-term support by governments - especially with legislation that stimulates energy and environmental development (Garud & Karnøe, 2003; Ornetzeder & Rohracher, 2006). Also important are the skills of people from these initiatives to collaborate with other organizations at local and national level, and a so-called fostering cultural and political context. The main barriers are a lack of government support and a lack of resources such as finance and technical expertise (Bomberg & McEwen, 2012; Seyfang et al, 2013).

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1 tayloristic, comes from Taylorism, also known as scientific management. Taylorism, named after Frederick Winslow Taylor, is a management theory, that analyzes how productivity of workers can be increased.
In history interesting examples of cooperatives can be found, that became major companies or entire sectors. Currently, the cooperative organization is regaining popularity quickly. Cooperative institutions are interesting since they are controlled and organized by the participants, as is the case with many local energy initiatives. The examples Hess & Ostrom (2006) describe relate mainly to the risk of over-exploitation in a particular area, such as fishery, forestry and agriculture, but it is interesting to apply the factors they describe to energy. These interesting factors are: clarity about the extent of the collectivity, matching policy to local conditions, guaranteeing the involvement of all relevant actors, balancing local rules and responsibilities with external authorities and governments, systems to monitor local behavior and mechanisms for conflict resolution that are accepted by the participants. However, Hess & Ostrom pay less attention to the interactions of physical, social and technological changes, which are quite important for a better understanding of the development of local energy initiatives. These developments also ask for modifications of roles and responsibilities of professionals. These modifications need to be further explored.

**Case 1 - De-burdening - Rapids Rental - Heerhugowaard**

One of the two examples of district renovation part of Rapids Rental was the Schrijverswijk in Heerhugowaard. End of 2013 the first prototype homes were realized. In early 2014 contractor BAM executed the retrofitting process of five occupied dwellings for housing association Woonwaard. In late October 2014 49 properties were retrofitted. The plan is to retrofit in total about 650 homes in the coming years (Woonwaard, 2015). The information used for the rest of the description of the Rapids Rental case study is mainly derived from the report of the project visit on April 7, 2015. This is therefore the main source of this paragraph. If other sources are used this indicated in the text.

**The retrofit concept**

The renovation concept consisted of the following elements (BAM, 2014a; Energiesprong, 2015):

- insulated prefab roof panels were applied over the existing roof
- 28 PV panels were fitted to the roof
- insulating facade components were placed outside the existing brick wall, these components were covered with a composite material which is light and waterproof
- a heat pump (air to water) is installed for space heating in a separate service module placed next to the house in the backyard, hot water pipes are integrated in the walls
- heat recovery ventilation (module in the service module), ventilation channels are integrated in the lower sides under the gabled roof of the attic
- a new kitchen, bathroom and toilet are installed using glass wall panels
- an induction cooking unit is applied in the kitchen, in order to make the house all-electric

The prerequisites of the Rapids programme were that tenants will pay the housing association an energy performance fee instead of the energy provider, while housing associations will invest the money in retrofitting of dwellings and builders will transform the houses into “zero-to-the-meter” (Stroomversnelling, 2013). The yearly net energy consumption will be (nearly) zero, thereby guaranteeing that the total cost of rent and energy will remain the same for the tenants (Energiesprong, 2015). The height of the energy performance fee, paid by the tenant, is based on the average energy cost over the past three years. If the tenant consumes more energy than expected then he will receive a bill. Like before, this bill will come from the energy company.

All homes are equipped with PV. The end-terraces have two extra panels because they consume a little more energy. The power generated on top of a specific home is delivered directly to this property. The energy warranty provided by BAM is based on the principle of a bundle, as is common practice in telecom. The bundle is based on general data concerning energy consumption, water use, etc. Residents can spend their bundle any way they want. Are they running short, they pay extra because electricity has to be obtained from the grid. Residents get a refund when there is some bundle left. This concept was thought out nationally, and introduced in this project by the Energy Leap programme. New blocks generate a little more electricity. Here 100kWh extra is generated per annum due to more efficient PV-panels.
Approach towards tenants and their experiences

Before the project started, the builder asked tenants if they were interested in a “zero-to-the-meter” retrofit. Normally people are approached by the housing association with this question, so this was new. Woonwaard offered to add a housing consultant as support next to the employee from BAM, but this was rejected. “Give us the opportunity to tackle this ourselves,” they said. The builder explained to the tenants what the process entailed and what the consequences were. Tenants were also invited to tour the model home. The reactions were very positive. Most tenants directly agreed, some needed extra explanation and more time to think the offer over.

In terms of information the following activities were performed for residents in order to prepare them for the home-renewal and to provide user support:

- tour of the model home,
- explanation of delivery,
- a service day after three months
- a service point was established
- opening of a website with login for residents with access to their energy data.

Afterwards the residents are very satisfied with the retrofitted dwellings, according to BAM. They particularly liked the new look of the home, the new bathroom, lavatory and kitchen but also the increased comfort levels of the house. The contractor assumes this last element has to do with the fact that the delivery was during the cold period of the year. Residents noticed directly their own homes were much more comfortable now than those of people whose house had not been retrofitted.

Woonwaard had expected complaints of the residents due to lack of experience with the new installed induction cookers. They delivered the new kitchen with new pots and pans, but almost no complaints were made. Only one family has put a different stove on top of the induction cooker and one Iraqi family continued to cook on the BBQ in the backyard.

The tenants were however not so pleased with the course of the implementation process. The tenants remained in their homes during the execution. This proved to be a rougher experience than expected, particularly with regard to the building activities inside the house. BAM and the residents agreed they have both underestimated the impact of the implementation process. Before the start BAM had communicated that the renovation work would take two weeks. In practice, however, this turn out to be three weeks. These four to five extra days were mainly due to work in relation to the finishing of the ceilings, skirting boards etc. The residents experienced this delay as very stressful.

In April, a year after delivery, there are still issues to be untangled in the conversion from rent and energy bill towards total housing costs. Especially the issues regarding the conversion of the energy bill from the energy provider and the grid managing company towards the housing association in combination with an energy provider that fits with the new concept proved to be complicated. The builder needed to communicate to tenants without an overview of the specific situation they are in, since BAM is unaware of the communication from energy provider and grid management companies to the tenants and has no overview of the billing and payment history of the tenants. This makes it almost impossible for the builder to service the tenants in an appropriate way. The different energy companies also do not have the same arrangements. Nuon for example does not count standing charge for the tenants when they do not use energy, but Oxxio does. Residents were informed that they could change their energy provider, but not everyone did. Now some people do not understand that they still get a bill from the energy company. For complaints they approach BAM. For BAM it is difficult to help the tenant since the company has no idea if a bill was send because former payments are still overdue or for some other reason.
Experiences from the contractor

The builder had to integrate innovations in their process in order to meet the short turnaround time. Four things were important:

- Focus on the structuring of the work on site - BAM has a long tradition of organizing work on site in workflows. A similar process was rolled out for the retrofitting in the Schrijverswijk. There were e.g. 5/6 working days required for renewing the bathroom, kitchen and toilet. The process was optimized for a row of houses and meant that one team would perform the demolition work of the lavatory, while the next day another team would fit out the new one. As a consequence the demolishing work was done before the weekend for some homes. The residents did not appreciate this, since they had to use external facilities for two extra days over the weekend.

- Supply chain integration - The builder experienced that a Rapids project is very much a supply chain effort. So co-ordination proved to be key in the whole process. They therefore decided to bring suppliers into the development process. It was also their goal to diminish construction errors at the same time. They experienced that the pace at which innovations can implemented has it limits. According to BAM the pace is determined by the time suppliers need to uptake the necessary new steps.

- Prefabrication and new technologies to speed up the pace of the work - Work was transferred to off-site locations by using prefabricated components, e.g. a prefabricated service module in combination with facade and roof components was used.

- To diminish errors - The supply chain of BAM now makes much more use of 3D modeling, Revit and BIM. One house of the project is completely scanned with 3D equipment and converted into a 3D model. This model house is used as a basis for the other dwellings. For the other properties only 3D scans of the bathroom and lavatory are made. The planning and budgets are coupled to the model, after realization the model is used for maintenance purposes.

The initial planning of the work prescribed to start with two new homes every working day. Since the finishing caused delay, it meant that at a certain moment work was going on in 25 to 30 homes. This was never foreseen and hampered proper communication from the builder to the residents. BAM experienced that communication with the residents can be tricky. People like to be addressed personally, but before you have spoken with everyone, some things concerning the work might have been changed again. The employee responsible for preparing the work on-site, was also in charge of communication. She noticed that personal attention to people is paramount, especially the social part of it, not so much the technical aspects. She experienced that some residents will never understand what is going on, despite all the information that is provided to them. This person now regards particularly the social part of communication as troublesome. "I'm not trained for that", she claimed. She is unsure whether she should remain responsible for the communication in the future.

Case 2 - Co-creation and co-production - LALOG - Energy Expedition Apeldoorn

In 2011, Apeldoorn saw the launch of the Energy Expedition Apeldoorn (#ENEXAP). The municipality of Apeldoorn was curious to find out how many of its residents were interested in making their homes energy neutral, and placed an announcement in the local newspaper, Stadsblad. A large group of homeowners came to the meeting. This resulted in a group of 33 households that started as part of the Expedition in May 2011, growing to 38 households, during the process. Its ambition is to make it technically and financially possible to owner-occupants to retrofit their home, making them energy neutral. The expedition team comprises of local residents, businesses, civil-society organizations, the municipality of Apeldoorn and the local University of Applied Science, Saxion. It was supported with a subsidy from 2012 until December 2014 as part of the Dutch government's Energy Leap programme. The Expedition’s goal is to refurbish a minimum of 20 homes making them energy neutral, taking as starting point the input from occupants. The homes are all different, but the owners all want the same thing, namely to reduce their energy consumption. In collaboration with businesses and professionals, and through meetings, excursions, workshops and by filling in a step-by-step plan on the website, they gathered information about their personal situation, the energy performance of their home and the possibilities available for them to save energy and generate energy themselves. Businesses were
encouraged to develop an integrated approach for owner-occupants, and consortia were set up by businesses that have the products, services and strategy to meet this demand. The ultimate goal is to boost the demand for energy-neutral refurbishment, encourage an appropriate supply of services, and have the refurbishment work actually carried out.

**Involvement of the occupants-owners**

The organization of #ENEXAP consists of a board of residents, a representative of the municipality and a representative of the local University of Applied Sciences. Next to the group interested in reaching energy neutrality, there was a group of followers who want to save energy, but not did not (yet) want to commit themselves to the ambition of energy neutral.

After the founding of the expedition, working groups were started to address different relevant issues. There were several working groups for technical issues, EPA Super Luxurious, finances and communication. The communication group made a website to monitor progress and to serve as a discussion platform. This group also organized excursions to energy neutral projects or other sustainable initiatives.

At the end of 2014, nearly 26 owners went through every step of the roadmap and many have received a detailed quote of one of the consortia. The overall result of the Apeldoorn Energy Expedition is that in June 2015, after being roughly four years en route, there were five houses well on their way to become energy neutral, three consortia were formed and residents have started to save considerably on energy cost by being aware of their energy use and making alterations to the home, replace e.g. lighting, refrigerators, freezers or switching off close-in boilers or water beds.

**Instruments and approaches developed**

During the course of the Energy Expedition Apeldoorn several products have been developed. The main products are:

- QuickScan - residents get a quick scan to reflect feasibility of zero-energy ambitions for their homes.
- Pilot EPA Super Luxurious - an extensive survey and matching advice, which also included financial options.
- Energy measurement in the homes with a Plugwise set
- Training & lectures for residents and consortia
- Visits to energy neutral homes and other example projects
- Roadmap for the occupant-owners as a means to aggregate all the information necessary about their homes and current energy consumption
- Website to structure all the information residents gathered and to exchange of information (forum)
- Assistance for occupants from energy directors
- Field Day for appraisers
- Scrum sessions with the different disciplines from the consortium present at the kitchen table of an owner-occupant to come to a plan

**Experiences from the professionals**

At first large contractors were linked to the initiative: BAM, Ballast Nedam and Linthorst. They have dropped out because they are primarily interested in larger building projects in which terraced houses with a high level of standardization can be addressed block by block. The houses part of the Expedition are, however, of varying types, spread around Apeldoorn.

The companies that remained linked were local SME’s. During the course of the Expedition two courses were held. The first course consisted of two parts. Goal of the first part was for owner-occupants to learn to articulate their specific desires and needs and to help them making explicit what aspects companies should address in their offer. The other part of the course was aimed at the professionals. How should they approach this market? Two consortia and some separate SME’s were present. During the course it became clear to these separate SME’s that the formation of a consortium was paramount. The separate companies decided therefore to form a consortium as well. It appeared to them the only way to be able to provide multi-disciplinary offers as requested by their clients. While there was a reasonable amount of general distrust from
residents towards contractors, time was reserved to put these feelings on the table and to discuss them. This was not an easy session for the professionals, but necessary in order to clear the air. At the end of the first course the companies had to present their consortia and their approach for three different housing types on April 23, 2014\(^2\). This was a lot of work for the companies involved and was experienced by them as rather stressful. How would the people respond? It appeared it was not easy for them to pick out the best spokesman from their midst. Some professionals proved to be natural performers, others had more difficulty to get their message across. After this session the owner-occupants whose houses were discussed made a choice for a consortium.

From here the process continued. For the households there was help from an energy director. The people themselves could choose from two experienced advisors. The energy director helped them to make a choice for the consortium that fitted their requirements best. Now the consortia had presented their approach it became much easier to see what approach would fit a certain assignment, what would be a personal match and would fit with the sort of assignments the consortium was in the market for. In the process that followed it became clear that it would be necessary that a consortium would really comply to a certain energy performance and preferably that they would be willing to give some kind of warranty. The owner-occupants were a bit hesitant to spend large amounts of money without knowing what the outcome would be. Energy performance and how to make arrangements with clients about this was therefore topic of the second course provided to the companies involved.

**Analysis – attention and room for occupants**

The large scale on which we want to address “zero-to-the-meter” retrofitting of houses is quite new, therefore new roles and interactions are emerging in this market. To get a better understanding of the impact on the role of professionals in construction and the options they have for involvement of occupants in the quest for affordable approaches to transform houses into “zero-to-the-meter”, this section focuses on what is emerging in the interaction between professionals and occupants in the two case studies. The potential in the approach of tenants in Rapids Rental has not yet reached it full potential, nor has it in the LALOG case study. There is room to offer additional value, in the form of options and services to the tenants. We will analyze the different initial directions in which attention and room is offered to occupants as a start to look for more unlocked potential that can be made available in the future. By analyzing the nature of the different factors already included in offers by professionals in construction and by looking at why specific disappointments and complaints arise at the side of occupants, an overview of factors can be determined that form a palette of options that can be used in building future business models around appealing propositions. These can be categorized in three different groups:

- factors in which value is added to either occupants or the community (thermal comfort, additional space, beautification, future proofing, value for money and value adding for the community);
- factors that facilitate a smooth process for the occupants (one-stop-shopping, pleasant customer journey, personal advise, performance guarantees and adding a wow-factor) and
- the possibilities for choices products & services on offer (providing choice, openness of products for add-ons, integration with DIY, additional services for occupants and additional services for housing associations).

**Add value: thermal comfort, additional space, beautification and / or future proofing**

In practice the residents involved in the Rapids Rental case study appreciated the improvement of the comfort level of their house. In these houses the windowsills attract attention. After the retrofit they can be used as bay windows to sit in, or to display objects. Substantial extra material is added to the facade while the glass panes are moved outwards, thereby leaving more space inside. Since comfort levels went up, the house feels bigger to residents because now they can really use the entire house. Especially the bedrooms upstairs are no longer used for sleeping only, but for activities like homework and hobbies e.g. (Oostra, 2015a).

\(^2\) Link with an impression of this session (in Dutch):
One of the house owners fell in love with another concept not on offer by the consortia related to #ENEXAP: prêt-à-loger\(^3\). In this concept the energy measures were much more integrated and extra value was added to the house by creating a conservatory. But this concept was not available on the market yet. In general people were already so well informed during the 15 months of lectures and information gathering that they more or less could have predicted the offers from the consortia themselves.

In the Rapids Rental programme specific attention was given to the beautification of the houses (see also Oostra 2015a). This was very much appreciated by the occupants, and some of them even said they had the impression they were now living in a purchased home. With the design of the retrofitting concepts and associated building components of Rapids, a high level of spatial and architectural quality was pursued. This was actually one of the biggest challenges of the industrialized systems being developed within Rapids: to ensure good architectural design and take regional and local differences into account.

And finally, some of the older house owners in #ENEXAP wanted to prepare their home for living on the ground floor. They realized they have another time horizon than the younger owners, and asked the consortia to propose them what kind of changes to their home would help to future proof their homes while making it energy neutral at the same time.

**Reasonable value for the investment made**

In the #ENEXAP case there were a lot of questions considering the price of the energy measures in comparison with the value they represent. The possibilities for financing of the retrofitting had been part of the investigations. For most people this was not a real issue, because they had considerable savings on their account that could be used for this purpose. However to really convert the house towards energy neutral, especially by heavy insulation measures, proved to be very costly. People were worried they would never reach the break-even point or would be able to reclaim the investment once they wanted to move. For some people this even became the reason to sell their home and build a new one. For the consortia it was an argument to include pellet stoves instead of heavy insulation measurements in almost every offer they made.

**Value adding for the community**

There is another category of value adding thinkable that was not part of one of the case studies. In areas with a shrinking population, were the amount of unemployed people is considerable, there are experiments that (temporary) include pensioners and local unemployed people as employees for the contractor during the retrofitting process. And in starting a neighbourhood company, some people can get little jobs in the operations and maintenance after the retrofitting. These people have an additional advantage, since they are already present at the site, which makes it easy for them to monitor the situation (Tankink, 2015). Until recently the development of new housing projects, complex retrofitting projects or their maintenance were tasks for professionals only. With such an approach it is possible for occupants to get (temporary) jobs, which could make the programme extra attractive for specific neighbourhoods.

**One-stop-shopping**

The questions the builder in Heerhugowaard got from occupants concerning their energy bills showed they expected one stop shopping. The tenants automatically approached the builder with the questions they had. And there was still a considerable amount of questions concerning the energy bills, a year after the delivery of the retrofitted houses, that proved to be difficult to answer. This task was almost impossible to solve for the builder, since they did not have all the necessary information. This leaves us with the question how far should everything be integrated for occupants? Is it necessary to make energy providers and the network operator a partner in retrofit projects?

**Pleasant customer journey**

At the start, residents from the Schrijverswijk in Heerhugowaard were very positive about the retrofit. Also the

\(^3\) [http://www.pretaloger.nl](http://www.pretaloger.nl)
final results were very much appreciated. But the work on-site left residents and the builder with the idea that there is room for improvement. It turns out that in the case studies four sorts of nuisance were encountered. The first type of nuisance was an issue that proved to be rather difficult for the consortia in the #ENEXAP case: a well-paced follow-up in the process before the owner-occupants got a quotation. The follow up from the three consortia to the house owners turned out to be slow, irregular or even absent. For the companies it felt the amount of work and the possibilities for work were not in balance. The energy directors came up with ideas to stimulate the consortia to improve their service and to speed up the interaction with the client. For this they e.g. developed scrum sessions.

A second type of nuisance to overcome was time loss during the preparation process. One important aspect proved to be waiting because of lengthy permit application procedures. In order to solve this, a Taskforce Licensing was created in the Rapids Rental programme (de Stroomversnelling, 2015). This taskforce ensured that the procedures for e.g. environmental assessment and the Flora and Fauna Act, necessary for these kinds of retrofitting projects could be dealt with quickly. The concepts used in the Rapids Rental programme were designed to meet the requirements defined in zoning regulations, the Building Act and the Flora and Fauna Act.

Another kind of nuisance to diminish was hindrance during the execution of the retrofitting work. Obviously the duration of the work performed on the house should be according to the announcements made. Still then, three weeks is too long considering the additional targets set by the Energy Leap programme: a maximum duration of the works in and around the house of 10 working days. Another example in this respect is the manner in which the process of the builder was structured in the Rapids Rental case. This process determined the rolling out of the retrofitting without much consideration of the consequences for the tenants. This meant that the lavatory could be demolished just before the weekend, leaving the tenant with external facilities for two more days. This was not experienced as customer friendly. BAM considers now to reorganize the process and to install a team that will demolish and renovate the lavatory in one day. The housing cooperation with experience with a similar conversion of the same builder in Emmen and Nieuw Buinen suggested the following process (Oostra 2015a): a one-day conversion for each of the different elements: lavatory, kitchen, bathroom and outer skin. With a day for remaining work and polishing up, this would result in a conversion within a week.

Finally, disturbance during the use phase had to be reduced e.g. due to maintenance and repair work. In the Rapids Rental case there is noticeably more attention for maintenance, since this was part of the contract. The builder started to include possible maintenance consequences into the decision making process when considering different products. The builder decided e.g. to use Spiro ducts for ventilation and not the rigged square tubes because it is nearly impossible to clean them. The service module can be considered a practical idea as well, since the system components can be assembled off-site and placed in one go, next to the house. This module isolates the noise making installation components from the people inside the house. And the separate service module allows them to perform maintenance activities without entering the home. Since the service module is placed in the backyard the tenants probably still have to be home to allow access for service via the back gate though. On the other hand, in the eyes of the tenants the extra service module does not represent additional value. A tenant who was visiting the model home uttered: “But I have no space for frying!” Indicating she would have preferred to have the extra room of the service module available to isolate frying processes from the kitchen and the rest of the house.

**Personal and integrated advise**

From the case study in Apeldoorn it can be concluded that from the start it would seem that the owner-occupants as part of a local initiative, that started to organize supply for their own specific needs, would have more options to choose from then a tenant that is approached by his housing association or other representative for a retrofit from the Rapids programme. The owner-occupants would get an offer tailor-made to their home, own specific desires and situation. In practice we have seen that it means that the #ENEXAP initiative is regarded as a niche for companies without the security that it will unlock a market with bigger potential. This in contrast with the builders that were able to make arrangements for a series of projects with the housing associations in Rapids Rental. This led to the consequence that the total package offered to owner-occupants did not go beyond the stage of bricolage. Although of course professionals will be able to use this package as a basis to improve the house as a whole, in practice it turned out that the tenants were better
off than the owner-occupants. The measures the tenants got were much more integrated, had a better cost-value ratio and the tenants were surprised by the level of comfort, the quality of the kitchen, lavatory & bathroom and the pans they got together with their new kitchen. They were more enthusiastic and even more surprised than the owner-occupants from the LALOG case study. In the end this resulted in only five owner-occupants deciding to give an assignment for retrofitting. Obviously this had to do with the effort and money they had to put in themselves.

Expectations of owner-occupants involved in #ENEXAP proved difficult to meet, especially, since they had gathered so much information in the course of the process, the companies seemed to be overtaken by their own customers. It proves hard to keep up, e.g. as a builder with all the new developments for new installations. The owner-occupants are committed to invest large amounts of time in information gathering and are often well educated and interested in technology. The owner-occupant is of course already leading when it comes to knowledge of the specific situation they are in and personal desires. Some representatives of companies had the propensity to fill in what their clients wanted or to systematically ignore explicitly formulated requirements. They did so because they did not oversee specific types of demands or because they thought it was not a wise choice. This put clients off. In fact in the end you would hope that these owner-occupants soon profit too from the concepts, processes, components and services developed for Rapids once they come available on the market.

**Offering of performance guarantees**

In the #ENEXAP case the technical integration of different energy measures was not anywhere in scope of the companies involved. In the other case study it was, since the contractor knew he had to transform a considerable amount of houses of the same type. This is probably also the case, because the builder in the Rapids case is already responsible for the energy performance guarantee and for maintenance.

**Add an unexpected pleasant surprise; the wow-factor**

After the presentation from the consortia to the occupants of #ENEXAP on April 23, 2014, people were a kind of disappointed. Three different approaches were presented for three very different houses. Each of the three consortia presented their suggestions for making the home energy neutral. There was a great turn out for this meeting since people were very curious to hear with what combination of energy measures the three consortia would come up with. Afterwards people were happy to finally know what kind of solutions the companies would propose. But there was also some feeling of disappointment. The proposed approaches were all three more or less the same in their eyes. People had the feeling there was not much to choose from, only the combination of companies, since the approaches were similar. And several people mentioned they missed a feeling of surprise. In the Rapids Rental case there was an unexpected surprise in the new pans they got with their new kitchen, but also the unexpected increase of comfort and the quality of the kitchen made that the tenants felt pleasantly surprised.

**Providing choice**

In the Rapids Rental case study retrofitting of the envelope and HVAC systems is often accompanied by other refurbishments. Often the kitchen, lavatory and bathroom are addressed. For housing associations it is usually important that residents have some elements relevant to them from which they can choose. This can consist of pure esthetical choices e.g. the color of the glass panels in the kitchen, or some additional elements like an additional dormer (not offered the Rapids Rental case study) for which tenants need to pay some extra rent.

In the #ENEXAP case the house owners expected to be able to choose between different energy concepts. The consortia on the other hand, were limiting the choices available, since they were insecure how the different options would work out in reality. They felt like they had to keep repeating calculations and rewriting their offers and were unsure whether or not they would ever get an assignment.

**Openness of products for add-ons**

In the Rapids Rental case study BAM worked with IKEA kitchens, which tenants can easily adapt to their own needs by buying extensions in an IKEA store. This kitchen created options for the residents that make it really easy to make alterations or add-ons, e.g. extending the kitchen with extra cupboards, change the color or style
of the doors, add an additional pan rack, spice rack or matching cutting board.

**Seamless integration of do-it-yourself activities from the occupant**

The professional world of construction and the consumer market or do-it-yourself world are clearly separate worlds. There are indications that this is slowly changing. IKEA is now officially partner of a contractor for retrofit projects in Rapids Heerhugowaard. And in Apeldoorn some owner-occupants had already implemented quite some energy measures themselves, since they already committed themselves to environmental issues long ago. The future will probably lead to more integration between the two. This will make it possible to respond appropriately to the desires and needs that occupants are likely to have when their house is retrofitted, but don’t have the required budget available. Professionals could anticipate on house owners who would like to do a part of the work themselves by provide do-it-yourself packages, advice and make the actual work optional. This will however raise issues regarding the quality of the work and can lead to problems since people do not immediately understand that details can be essential when it comes to airtightness and insulation values. Especially when people have to increase the mortgage, financial institutions will want to make sure the energy performance indicated in the plans are really met. This will need some time to develop, while at the moment financial institutions that provide mortgages are still not able to trade the increased spending limits of customers due to lower energy bills for more lending capacity.

**Additional services**

An other housing association, Lefier, not part of the case studies but involved in the Rapids Rental programme, indicated that they prefer to have from the contractors clear packages they can offer to tenants for a fixed price. These could be completed with a suggestion for the rent increase that could be asked from the tenant. As a client, housing associations want to have similar options to choose from, like tenants or owner-occupants. There is overall a lot of unexploited potential to develop services and products that are of interest for different clients, being tenants, owner-occupants and housing associations.

Also the false expectation people had in Heerhugowaard indicates something valuable. Tenants thought it is only logical to include other jobs in the house to the retrofitting process so that all the work could to be done in one go. For example when new interior doors had to be fitted or troubleshooting existing problems with an outlet was needed. These activities were held separately from the retrofitting process, but to tenants this did not seem logical. In addition you could raise the question whether or not there are opportunities for additional services. Why not offer additional services as a builder? These could be the application of new wall, floor and/or ceiling finishing, repairing damage done to the garden, or improving the garden or other services and options. Would it be possible to commercially pick up questions for new interior doors or application of wallpaper as a builder directly with a tenant? Or would this be confusing for the tenant? Maybe it would only be a matter of different financing options: the tenants can choose whether they pay for the dormer by paying additional rent to the housing association or a fixed price to the builder. These additional services can be taken on by parties such as IKEA or be seen as new commercial opportunities by the smaller local building companies.

The outline of the Rapids Rental programme introduced a type of service for tenants that was also new to the builder and housing association: offering energy, water and a home instead of house rental only. The role of BAM as builder extended with this service. They now monitor how people use their energy bundle and are considering to introduce a feedback system via SMS or app for the residents. This would allow tenants to receive a message when they have consumed over 75% of their bundle or have reached the end of it. Thinking about services related to the energy bundle might open up the minds for other additional services for tenants that are not originating from construction.

**Services directed at housing associations**

Communication with the tenants was different in the Rapids Rental project. New was that the builder approached the tenants instead of the housing association. First, residents were asked by the builder, whether they were interested in a “zero-on-the-meter” retrofit of their home. There was great enthusiasm and therefore the project went on. The builder kept the communication role throughout the retrofitting project.
Providing the service of taking over the communication from the housing association and providing maintenance for a certain period can be a starting point for the development of other services directed at housing associations.

**Good stewardship**

A question remaining for professionals in construction is what the consequences are of a client-focused way of working. Does it mean dealing with requirements that are explicitly formulated by clients only? Or do professionals need to include the goals of policy makers who are anticipating overall trends? E.g., like the Rapids programme is anticipating an increase of energy prices and the consequences of rising CO2 levels. In the future additional policy goals for other resources can be expected. If these should be included, how to deal with cherry picking that can be expected from occupants? Seduce them with adjustments these occupants want to have now and inventing clever offers to include the policy goals that will take much more effort to get across? Or see this additional work as a way to realize the wow-factor in the eyes of clients? Or is it legitimate as a professional just to wait for regulation to be forced upon everyone? On the other hand, national government, municipalities and housing corporations are starting bottom-up initiatives in order to realize policy goals. They reason that it is impossible for them to accomplish all these policy goals without local citizens and companies. #ENEXAP is a good example of this.

**Conclusions for professionals in construction & Open Building**

In the supply driven market that developed after the war, occupants used to be regarded as some sort of disturbance in the quest for rationalization and industrialization. Now society is changing, clients are being rediscovered as a valuable starting point for business. Clients and society as a whole ask more from the industry, therefore companies and professionals need to organize themselves to be able to integrate additional information and knowledge to make interesting offers. Hereto knowledge of different domains will have to be integrated: e.g. needs, requirements and drivers of different client groups; energy, comfort & care concepts; construction, installation, maintenance, performance guarantees, Total Cost of Ownership, consequences for value development of property, financing options, marketing etc. Professionals will have to come up with answers to all sorts of questions and innovations to be able to give an integrated advice to their clients: housing associations, tenants and owner-occupants. The two case studies show that multi-disciplinary collaboration across all sorts of domains is a prerequisite for the development process of integrated retrofitting concepts. In the past, work was arranged in such a manner that problems were dealt with mono-disciplinary. This is no longer tenable. The question is how to deal with all the relevant information, knowledge, concepts, products and services even while they are developing. Principles of Open Building can help to structure the valuable input from all the stakeholders needed and leave room for personal preferences of occupants and for future developments.

Looking at the two cases the interaction between occupants and professionals can be characterized according two different approaches in relation to the zero-on-the-meter retrofitting of houses:

- **Customer-producer-relationship** – The builder takes on the role of producer who prepares a basic retrofitting concept fit for a specific housing type with options. The occupant can choose from these precooked options. In the Rapids Rental case study the options offered to the tenants were pre-selected by the housing association from the offer of the builder. The builder, the housing association or a third party can take on the communication with the tenants about the process and the options. In the Rapids Rental case study the builder took on this role.

- **Client-adviser-relationship** – In this scenario the owner-occupant expects a tailored and integrated advise from the professional that can help to realize the desired personal goals not only related to achieving zero-to-the-meter, but also other issues like extensions to the home, beautification, renovation, care facilities, future proofing etc., like was the case in #ENEXAP. To be able to take on the role of advisor the professional needs to organize him- or herself as part of a supply chain that is able to deliver integrated tailor-made solutions, which require the expertise of different disciplines. With the role of advisor the builder or construction supply chain can gain the trust of the owner-occupant and this may lead to an order of materials and equipment or to an assignment to perform (part of) the work required. The role of advisor can be taken on by the builder, but also by other partners from the supply chain or a third party like an architect, an advisor or a well-trained sales
In both cases it will be important to learn to understand different client groups. Actually, there will be a quest for companies to start to learn so much of client groups that they know more of the client than the clients themselves. That will make it possible to advise clients in the process and to help to predict what options have value for the owner-occupant or to people in general, in case the owner-occupant wants to sell the property. And it will make it possible to develop concepts, products and services that match the needs of specific housing types and client groups needed for the customer-producer relationship. Knowledge of clients will give direction in the sort of information, concepts, products, processes and services needed in a business offer. In these processes a matching mix of elements will have to be included that address the factors that were distilled from the case studies in the analysis section: factors in which value is added (thermal comfort, additional space, beautification, future proofing, value for money and value adding for the community); that deal with the process (one-stop-shopping, pleasant customer journey, personal advise, performance guarantees and adding a wow-factor) and choices, products & services offered (providing choice, openness of products for add-ons, integration with DIY, additional services for occupants, additional services for housing associations and good stewardship).

This means there are different ways to fill in the basic principle of Open Building of creating room for end-users. The influence can take on different forms: decision making, co-developing, co-designing and/or co-production. The case studies show there are different routes that can be taken and different factors can be included to create this room and make clients feel welcome as part of the process. The cases also show that a lot is required from professionals. Open Building can help to reflect on how specific practices are performing at the moment, what directions are possible for improvement and what future developments technology provides or what is needed to realize the envisioned improvements.

There are considerable consequences for different professions in a sector that had a hard time during the recession of late. The quest for products that make it possible to speed up the throughput of the retrofit process and become more client-focused led to further rationalization and working with standardized concepts. The question can be put what role will be left for certain professionals in the retrofitting process when the Rapids approach becomes the norm? What does it mean for architects? The mason? Or the tiler and the roofer? As an architect you can distinguish opportunities for a new role as architect. A good design keeps its value, even when developing and using industrial products. It will become a much more stepped design process, where architects are involved in at least two phases: (1) the development of the concept or industrial product the retrofit package will become and (2) the adjustment of the concept to the requirements of a specific project, context and kind of end-users. This means that the concepts that are now being developed should not just to meet the specific requirements of tenants and landlords, but must also provide the flexibility to respond to the local landscape and character of the district in order to integrate it into the context. On top of that, ideally should facilitate regional and local recognition of neighborhoods. It means possibilities for adjustment and the necessity to integrate knowledge that will be developed from different disciplines in process, concepts and components. And not just the traditional disciplines from construction. This will raise new questions and create opportunities for Open Building in the coming decades.

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