Session 2.11: Processes, Design, Tools and Methodologies in SBE (2)

Decision Making in the Pre-design Stage of Building Renovation Projects

Anne N NIELSEN[a], Tine S LARSEN[b], Rasmus L JENSEN[c], Søren B NISSEN[d]

[a] *University College of Northern Denmark, Denmark,* anni@ucn.dk
[a] *Aalborg University, Denmark, anni@ucn.dk*
[b] *Aalborg University, Denmark, tsl@civil.aau.dk*
[c] *Aalborg University, Denmark, rlj@civil.aau.dk*
[d] *University College of Northern Denmark, Denmark, sbn@ucn.dk*

ABSTRACT

There is a great potential in renovating our existing building stock, in terms of improving environmental, economic and social qualities. Meeting the increasing performance requirements for sustainable construction entails an increasing level of complexity in the design process of both new buildings and renovation projects. Decision support tools are one solution that can help the building owner manage this complexity. This study investigates the current decision-making processes among Danish professional building owners, in order to propose a conceptual framework for future decision support tools for sustainable renovation. Design Science Research Methodology has been used as the main methodological framework. Current practices for setting goals for sustainability, determining the current state of the buildings and prioritizing which buildings to renovate within a building portfolio, have been explored through semi-structured interviews with five professional building owners. The study showed that there is a need for tools to support the professional building owner in setting goals for sustainability at an early stage. Tools to support the registration of existing buildings and prioritization among buildings to renovate were not seen as a direct need among this specific user group. This work proposes a conceptual framework for future decision support tools based on the findings, focusing on setting goals for sustainability within renovation projects, either within a sustainability assessment scheme (e.g. DGNB-DK), or project specific sustainability criteria. The results presented in this paper are a part of an ongoing research project focusing on developing a new decision support tool for sustainable renovation.

Keywords: *decision support, DGNB, deep building renovation*

1. INTRODUCTION

Buildings are responsible for more than 40% of energy use worldwide, and one third of global greenhouse gas emissions, causing increasing attention on sustainable development within the construction industry. Along with tightening the regulations for energy efficiency in new buildings, the Danish government sees great potential in improving the energy efficiency in the existing building stock (Danish Ministry of Energy Utilities and Climate 2014). Broadening the perspective from the narrow focus on energy efficiency to a more holistic approach to sustainability, the Danish building industry has chosen DGNB-DK as a common ground for assessing sustainability in buildings, encompassing social, economic, environmental, technical, process and site quality. The increasing demand for sustainable solutions entails an increasing level of complexity in renovation projects. Multiple decisions have to be made throughout the design process; sustainability criteria are numerous and often conflicting, and on top of that, sustainability goals are not always clarified at an early stage, which makes it even harder for the professional building owner to operate and manage decisions in a systematic and efficient way. Decision support tools are one solution that can help the building owner manage this complexity.

Prior to this study, a literature review has been undertaken (Nielsen et al. 2016). In the review, 43 existing decision support tools for building renovation were analysed and categorised in relation to where in the renovation process they can support the decision maker, along with a proposed road map for designing future decision support tools for renovation projects. This study builds on the findings from the literature review by investigating the needs in practice for Danish professional building owners, within the specific areas of setting goals for sustainability, registration of existing buildings and prioritization among buildings to renovate.

In addition to the tools included in the literature review, which were all documented in international scientific journals or conference proceedings, several tools have emerged within the Danish construction industry. The BDB-method (BDB-metoden Aps 2016) is a method designed for the building owner to manage the strategic vision from idea to construction and operation, with a flexible approach to sustainability. The BDB-method is intended to be used for both new buildings and in renovation projects. Another new tool is the BSV decision tool (Teknologisk Institut 2016), which goal is to provide a comprehensive and clear foundation for making decisions regarding energy renovation of buildings. The tool is aimed towards the professional building owner, municipalities, board of directors, advisors and contractors. A digital dialogue and prioritization tool for project managers in housing associations is currently under development; the tool is based on DGNB-DK and seeks to enhance dialogue on sustainability among the project managers, occupants and operation personnel, both in renovation projects and in new building projects (Den almene forsøgspulje 2016). The emergent development of new tools reflects the growing need for tools to support dialogue, communication and decision-making in the early stages of renovation projects among the different actors and stakeholders. The existing tools differ slightly in their aim and objectives, though revolving around the same main goal of improving the renovation process within the Danish building industry. In our opinion, developing new tools, and advancing existing tools, will only strengthen the common goal of improving the decision-making process in renovation projects.

This study contains interviews with five professional building owners so as to investigate how they currently set goals for sustainability in renovation projects, how they register the actual condition of the existing buildings and how they prioritize which buildings to renovate within a building portfolio. The study reported in this article is a part of an ongoing research process focusing on the development of a new decision support tool for sustainable building renovation aimed towards professional building owners. Involving potential users at this stage has been an important step to understanding the problem context. The main contribution of this article is a conceptual framework, which can serve as a foundation for future design and development of decision support tools for sustainable building renovation. Furthermore, the article provides useful insights into the decision-making process of professional building owners in Denmark.

2. METHODOLOGY

The methodological framework used in this research project is Design Science Research Methodology (DSRM). DSRM incorporates principles, practices and procedures of designing successful artefacts and has been widely applied in information system research. Peffers et al. (2007) have described the overall steps within DSRM as problem identification, defining objectives for a solution to the problem, design and development of the artifact, demonstration of the artifact, followed by evaluation and communication of the results. The steps are iterative, but the design and development take their point of departure in the problem definition. The results presented in this paper relate to the step of defining objectives for a solution, hereunder investigating a specific business context and developing requirements for a new artefact. Furthermore, this study follows the guidelines suggested by Hevner et al. (2004) for understanding, executing and evaluating research within Design Science Research. The method for data collection has been qualitative, semi-structured interviews with building professionals from three Danish municipalities and two housing associations. The municipalities and housing organisations chosen for the interviews are all professional building owners managing large building portfolios, with the vast majority of their construction projects being deep renovation projects. The themes of the interviews were based on findings from the preceding literature review, which suggests a roadmap for future development of decision support tools for renovation projects. In order to analyse the data, the interviews were subsequently transcribed, condensed and coded into relevant themes and sub-themes.

3. RESULTS

3.1 Decision contexts

The Danish municipalities are characterized by being political organizations, with internal departments responsible for building projects and building owner consultancy within each municipality. Technically, the building owners are other administration departments within the municipality, constituted by politicians in different fields, with none or limited professional knowledge within building design. The housing associations interviewed for this study also serve as building owner consultants, with local occupant administrations from the housing departments functioning as the “building owners” or decision makers. In both cases, the consultants are a part of the organizations, providing

a foundation for politicians or occupant representatives for making qualified decisions regarding potential construction projects, both new buildings and renovation projects.

3.2 Sustainability goals in renovation projects

The interviewed professionals from the municipalities and housing associations were asked how they currently set goals for sustainability in renovation projects in their organisation. It was concluded that both the municipalities and housing associations often do not have a formal procedure for setting goals for sustainability. Often, the goals are implicit and based on "what we are used to doing". However, one of the interviewed municipalities has recently developed a sustainability manual for both maintenance, renovation, rebuilding and new building projects, based on the DGNB-DK certification system, but slightly simplified and adapted to the different project types. They use the sustainability manual as a guide intended to be included in the building brief of their projects to ensure a focused and consistent approach to sustainability.

For the housing associations, the residents are involved in the decision of whether or not to renovate, and therefore their process includes a high level of occupants involvement. Their biggest challenge is to convince the occupant representatives to make sustainable choices, to "sell the idea" of sustainability, as they cannot always see the direct value they get in return for the increased rents following a renovation. For one of the housing associations, the goals are set from project to project; they have no standardised procedure for goal setting due to the high level of user involvement. For the other housing association, they have a goal to certify all major projects using the DGNB-DK assessment scheme. However, the initial choice to renovate one or more buildings stems from the administrative boards of the occupants. The housing association is currently in the process of certifying their first building, their own administrative office building, in order to gain experience and to evaluate the value of a DGNB-DK certified building. The housing association serves as building owner consultant, and because they are not the actual building owner, they can only inspire and "sell" the idea to the occupant representatives. Therein lies a challenge in implementing sustainability goals for their construction activities; they find it hard to convince the occupants to choose sustainable solutions. Also, they miss a common understanding of "sustainability" and feeling of ownership across the different departments in their organisation. Currently, only the construction department is concerned with the sustainability goals, but they wish to include the maintenance department and the rental department as well to ensure a common ground for their activities and goals. The importance of dialogue, both internally in the organisation and externally with included stakeholders, was addressed as an important issue, and one of the biggest challenges, for achieving sustainability goals, as well as prioritization and assessment of available options. Another organizational challenge faced by the housing associations is that they rely on funding from a public fund, and therefore they need to comply with the criteria valued by the fund to get their projects financed.

Interviewees from the municipalities addressed the issue of integrating political goals in the renovation projects as well as the issue of the politicians not being explicit in their goals regarding renovation. Not knowing what is prioritized on the political level makes it hard to implement specific goals in the renovation process. A strategic tool for enhancing dialogue among politicians and the building professionals was requested in order to strengthen the goal setting process and to make goals explicit. Furthermore, all municipalities address the organisational boundaries of their budgets being divided between a construction budget and operation budget as a major challenge in setting efficient goals for sustainability, because they are not entirely able to include a life cycle perspective in their decision-making and sustainability goals. It was specifically addressed by the municipalities that there is a need for a strategic tool that can support them in setting goals for sustainability.

All the interviewees address the importance of making explicit goals, e.g. the level of ambition regarding DGNB-DK certification, in the cases in which certification is a goal. The interviewees all agree that sustainability is important to discuss in the early stages. Also, a majority of the interviewed persons call for a common ground for the understanding and definition of "sustainability" among the included actors, not only at the early stages of the building process but also later, e.g. in the construction phase. None of the interviewees use specific tools for setting sustainability goals. However, they see their facility management system and other building administration systems as a helpful foundation for making informed decisions.

3.3 Registration of the current state of existing buildings

Another question for the interviewees was how they currently register the actual state of their buildings. All interviewees explain that they have a good idea of the current state of their buildings, and when they need deep renovation, due to on-site technical personnel. The interviewed municipalities recently started to collect and enter existing building data into new facility management systems. Before this activity, the information was stored in different places, such as physical and digital folders and Excel sheets. Up to this point, they had to rely on the specific knowledge of individual employees about the different buildings. Relying on knowledge from individual employees made it hard to transfer the knowledge because the process was not automated. Collecting and entering data has been, and still is, a comprehensive and time-consuming process. However, they expect that having their building data in one place will make the processes easier in the future.

One of the housing associations explains that they make an examination of the building before they start a renovation project and that the users take part in the building examination. The housing association mentions that e.g. creating BIM models of their existing buildings would be unnecessary and too time-consuming as they know their buildings very well and have employees on site who can easily find information on the physical building if needed.

As there are already well-used procedures and tools for registration of existing buildings among the interviewed user group, it is not considered necessary that a new decision support tool includes this specific aspect, but instead, extracts the required data from the facility management systems if needed.

3.4 Prioritization among buildings to renovate

The municipalities and housing associations were asked how they currently prioritize which buildings to renovate. After the need for renovation has been identified, the prioritization process is approached differently in the housing associations and municipalities. The housing associations have a democratic process in which the occupants have to vote whether or not to renovate as this will also entail an increased rent. For the municipalities, the prioritization lies on the political level where the politicians need to decide what to prioritize. Common is that all the interviewees act as advisors and have to communicate their professional recommendations, hereunder the aspects of sustainability, to decision makers that do not have professional knowledge in the field of building renovation, either politicians or occupants or other departments within their organisations. This makes their challenges comparable, however not similar, as the interests and background of the politicians and occupants might differ. To sum up, the prioritization aspect was not a big issue for the interviewees, simply because they are not the actual decision-makers themselves, but consultants who are providing or facilitating the decision process and priorities.

4. A CONCEPTUAL FRAMEWORK FOR FUTURE DECISION SUPPORT TOOLS FOR BUILDING RENOVATION

The need for communication and dialogue was highly emphasized among the interviewees, but the situations and needs are different for municipalities and housing associations. Therefore, it is recommended by the authors that one tool does not try to encompass all user contexts, but focus specifically on one user group, e.g. municipalities in Denmark, with the prospect of adapting the tool to different user groups and contexts. Based on the findings, the main functionality for future tools should be to help the user set goals for sustainability in renovation projects (Figure 1). If certification of the building(s) is a goal, future tools should provide a framework for setting goals for each criterion within the certification scheme. The certification schemes have predefined weights for each criterion so the user can estimate which criteria to prioritize and how many points they seek to achieve. If certification is not a goal, it is suggested that a weighting module is included in future tools, with the function of assigning weights to the chosen criteria, to reflect the values of the decision-makers. Based on the preceding literature review, the authors suggest encompassing the weighting method Analytic Hierarchy Process.

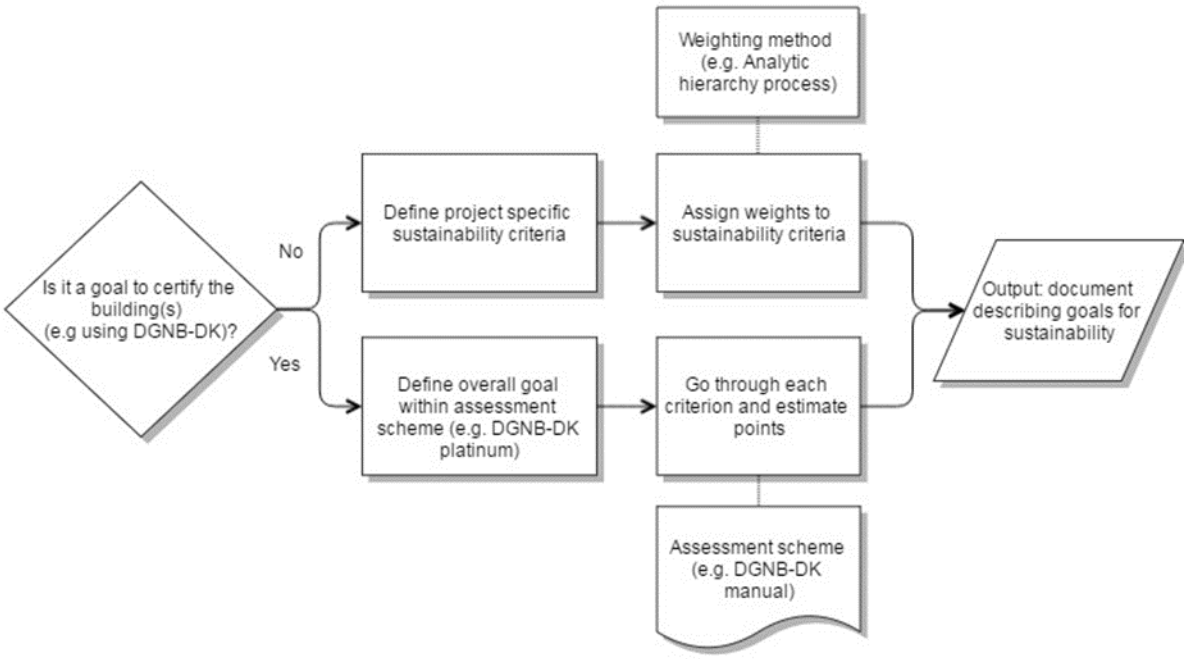

Figure 1: A conceptual framework for setting sustainability goals within renovation projects.

Providing a framework for setting goals for sustainability can enhance the dialogue between the advisor and the building owner and help ensure that goals are made explicit at an early stage. Furthermore, documenting sustainability goals early on can provide useful guidelines throughout the process, even though the goals might change later on. In that case, the tool could be useful at different stages of the design process if the goals need to be modified due to unforeseen factors. Also, the tool could be used in the design process to assess different design alternatives or to assess the final building if certification is not a goal. If the building is certified using DGNB-DK, points can be obtained by documenting sustainability goals in the early project phase. The tool could help provide this documentation.

5. CONCLUSION

The aim of this study was to investigate current practices among building professionals in Danish municipalities and housing associations in order to suggest a conceptual framework for future decision support tools for sustainable building renovation. The study has provided useful insights into how Danish municipalities and housing associations currently set goals for sustainability within renovation projects, how they register existing building data and how they prioritize which buildings to renovate. It was found that there is a need for a decision support tool that can support the professional building owner in setting goals for sustainability within renovation projects. A majority of the interviewees explained that they are already in the process of building a database of their existing building portfolio, for which reason it is not seen as a need to provide a new tool to support the registration process. Furthermore, it was found that prioritization among the buildings to renovate is not a task that lies directly within the departments of the interviewed building professionals and is, therefore, not suggested as a primary focus point in the context of this study. This does not mean that registration and prioritization are not relevant aspects to consider for future decision support tools, but it is not a need within this specific user group.

The results in this article reflect the insights gained from five interviews in a Danish context. It is suggested to focus on one specific user group in the design and development of future decision support tools in order to understand the users in-depth and, thereby, potentially increase the usefulness of new tools. Future research within this research project will focus on the design and development, demonstration and evaluation of a new decision support tool for setting sustainability goals within renovation projects in a Danish context. The focus of this article is on the decision-making process related to building renovation, but the suggested concept could be just as useful in setting goals for new buildings.

REFERENCES

[1] BDB-metoden Aps, 2016. BDB-metoden. Available at: http://bdb-metoden.dk/ [Accessed May 9, 2016].
[2] Danish Ministry of Energy, Utilities and Climate, 2014. Strategi for energirenovering af bygninger, Denmark.
[3] Den almene forsøgspulje, 2016. Den almene forsøgspulje. Available at: http://www.denalmeneforsoegspulje.dk/stoettede-projekter/igangvaerende-projekter.aspx.
[4] Hevner, A.R. et al., 2004. Essay in Information Design Science systems. MIS Quarterly, 28(1), pp.75–105.
[5] Nielsen, A.N. et al., 2016. Early stage decision support for sustainable building renovation – A review. Building and Environment, 103, pp.165–181.
[6] Peffers, K. et al., 2007. A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems, 24(3), pp.45–77.
[7] Teknologisk Institut, 2016. BSV-beslutningsværktøj. Available at: http://www.teknologisk.dk/energirenovering-2020/valg-mellem-loesninger-til-energirenovering-beslutningsvaerktoej/36652,2 [Accessed September 5, 2016].