

INVESTIGATING PEOPLES' PREFERENCES OF AUTOMATED INDOOR CLIMATE CONTROL FACILITIES

Sebastian BOTZLER^{1,2,*}, Jakub KOLARIK² and Bjarne W. OLESEN²

¹Department of Building Physics, Technical University Munich, Munich, Germany

²Department of Civil Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark

*Corresponding email: botzler@tum.de

Keywords: User-preferences, Smart-City, Building-automation, Communities

INTRODUCTION

Current ambitious goals regarding the reduction of energy consumption and CO₂ emissions cannot only be met by designing extremely energy-efficient buildings (Schubert et al., 2010). The integration of such buildings into well-functioning social and smart communities, which then create a so called Smart City, seems to be necessary regarding various aspects. It is generally believed that a building equipped with several high-technology features will not only work efficiently in the community context, but also that it will provide high occupant satisfaction (Kamilaris, 2013). However, in order to create this synergy of building and its social- urban environment it is not very common to ask people outside of the development process about their preferences, wishes and concerns. The present paper reports results from a survey conducted among different target groups as a part of Technical University of Denmark's (DTU) contribution to the Solar Decathlon Europe 2014 competition (Team DTU, 2013). The main objective of the survey was to map a level of usage of building/home automation in current dwellings, investigate people's satisfaction with automated features and explore their wishes/preferences in that field. Special emphasis was always put on the connection of the respondent to his social environment in his living area.

METHODOLOGIES

The survey was conceived as an internet based questionnaire including 29 questions. The respondents provided quantitative answers using radio buttons (yes/no answers), check boxes and 6-point Likert-scales (rating of satisfaction with home features etc.). A focus was also put on qualitative and text-based open-end questions to obtain the personal opinion of the respondents. The questionnaire was distributed to three different target groups: international respondents with various backgrounds (n = 189), employees and students of DTU (n = 96) and a group of Danish retirees (n = 19). Statistical significance due to effects of demographic parameters on obtained responses was evaluated by chi-squared test and in the case of Likert-scales by Mann–Whitney–Wilcoxon test. The p-level for rejection of the Null Hypothesis was set to p=0.05. Text based, qualitative answers were analysed both individually and by creating “word maps” from most frequent keywords related to the asked question.

RESULTS AND DISCUSSION

A main finding of the overall survey was the influence of certain socio- demographic factors on the amount of installed building automation. Whilst characteristics like age of the

respondents or occupation did not have significant impact, the ownership (owned/rented dwelling) influenced significantly ($p < 0.001$) the prevalence of dwellings with automated facilities (Figure 2).

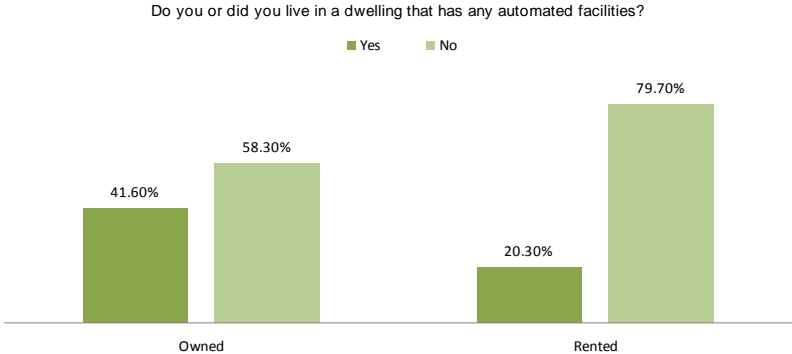


Figure 1. Dwellings with building automation with respect to ownership

Frequency of particular types of installed automated facilities varied a lot with respect to ownership. People who owned their dwelling have had built in more automated facilities (42 %). The renters on the opposite were not eager to invest more than their rent to get the newest technology (20 %). In this case it seems to be the task of the landlord to install automation if needed. Figure 3 shows a comparison of prevalence of installed building automation to what was requested by the respondents. It can be seen that heating was the most installed automated facility (31 %) and audio/visual (entertainment) systems were the most desired feature (26 %). In contrary automated heating/cooling was desired only by 12.9 % and automated ventilation by 17.4 % of the respondents. With respect to the fact that these systems have large impact on energy consumption, one could expect higher percentage of people requiring them.

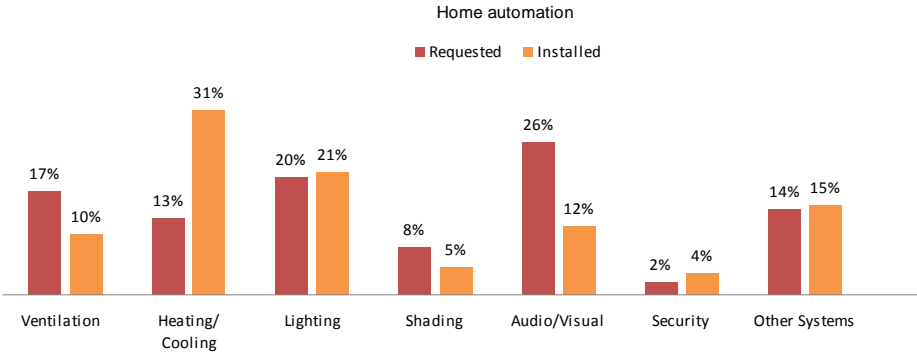


Figure 2. The results for requested and installed building automation

The qualitative analysis of the full text answers showed that respondents chose heating, lighting and large glazed areas as the most appreciated features with respect to indoor comfort. Air-conditioning had the highest prevalence on the list of unnecessary home automation features.

Although the amount of respondents in the survey was not very large and thus the results cannot be generalized to respective populations, the results provide valuable insights into preferences of regular citizens. For example it seems that building automation of facilities that should satisfy “basic needs” like heating or ventilation is mostly considered as luxury. As long as these systems operate trouble-free, respondents do not pay that much attention to the

technology installed in their homes. Moreover, they do not see an extra benefit in adding more automation. On the contrary, improvements and automation of systems that provide entertainment were desired much more. This indicated lack of awareness regarding importance of building automation as the tool for reduction of energy use in modern buildings. It also points out that interfaces of building automation systems should probably be integrated with systems/features providing entertainment to gain from the “gadget affinity” of future building occupants. One example of such integration can be so called Social Electricity Facebook application (Kamilaris, 2013). This tool included the comparison of various energy consume behaviours among friends and their homes and even created competitions out of the constellation. The survey also showed that tenants in rented dwelling did not pay much attention to building automation. The smaller was the binding of the occupant to the apartment the less seemed to be the motivation to invest in energy efficient equipment and even the general acceptance of building automation was high (82% of people who had experience with building automation indicated that these features don't influence their lives at all) Respondents that owned their houses or flats showed much more emphasis in using automation to improve comfort and save energy. This implies that to increase the amount of refurbishments and modernisation of buildings the awareness and the motivation of the building owners in particular, the landlords etc. needs to be stimulated. It should be task of the authorities to create needed incentives therefore.

CONCLUSIONS

- Amount of automated facilities in dwellings significantly varied with ownership. 42 % of respondents owning their dwellings indicated having automated facilities in comparison to only 30 % of respondents living in rented dwellings.
- Automated heating was most installed facility (by 31 % of respondents).
- Automated entrainment systems were most desired facility (by 26 % of respondents).
- Automation of climate conditioning systems seemed to be less important for respondents than other features of the house like audio visual/entertaining systems. Awareness of building occupants regarding automation of climate conditioning systems as a tool for reduction of energy consumption should be increased.

ACKNOWLEDGEMENT

Support given to the study by DTU's Solar Decathlon team is greatly acknowledged.

REFERENCES

- Schubert, J, et al. (2011) Habitats and energy consumption in Germany. Physical connection, prooperty rights and their impact on envrionmental efficiency. LMU Munich, Institute for Sociology.
- Team DTU (2013) Solar Decathlon Europe 2014. *Project Manual #3*, Technical University of Denmark, Kgs. Lyngby, Denmark, www.solardecathlon.dk (visited Feb. 2014).
- Kamilaris A, Pitsillides A, Yiallourous M (2013) Building energy-aware smart homes using web technologies. In: *Journal of Ambient Intelligence and Smart Environments* 5 (2), S. 161–186. DOI: 10.3233/AIS-130201.