 doi:10.20944/preprints201710.0064.v1

Article

People-centred approach for ICT tools supporting energy efficient and healthy behaviour in buildings

Ana Tisov[1*], Dan Podjed[2*], Simona D'Oca[1], Jure Vetršek[2], Eric Willems[1,] Peter Op't Veld[1]

[1] Huygen Engineers and Consultants, PO Box 521, 6200AM Maastricht, The Netherlands;
[2] Institute for Innovation and Development of University of Ljubljana, Kongresni trg 12, SI-1000 Ljubljana, Slovenia.
[1*]Correspondence: a.tisov@huygen.net; Tel.: +31 880 322 222
[2*]Correspondence: dan.podjed@iri.uni-lj.si; Tel.: +386 31 820 198

Abstract: This paper attempts to alter a prevailing assumption that buildings use energy to an understanding that in fact, people use energy. Therefore, to successfully accelerate the transition to a low-carbon society and economy more emphasis should be on motivating people and increasing their awareness by making them energy conscious building users and therefore active players in the energy transition process. In this context, this paper provides insights from the Horizon 2020 MOBISTYLE project. It demonstrates research and development approaches, highlights the main project objectives, and presents findings of an ethnographic (qualitative) study of users' habits, practices, and needs. The aim of the project is to motivate behavioural change by raising consumer awareness through the provision of attractive personalized information on user's energy use, indoor environment and health, all enabled by an integrated information and communication technology (ICT) service. In this context, the anthropological people-centred approach is integrated into the MOBISTYLE approach putting users at the centre of the ICT tools development process. The main quantitative objective of the project is a reduction of energy use for at least 16 % prompted by the provision of combined information and feedback systems on energy, indoor environmental quality (IEQ) and health. The most relevant motivational factors and key performance indicators (KPIs) for encouraging a more energy conscious and healthy lifestyle were defined by means of a people-centred approach, adopting anthropological inquiries in different settings. Information about users' lifestyles and their needs was collected in focus groups with potential users in five case studies, located in different European Union (EU) countries. Behaviour change is achieved through awareness campaigns, which encourage users to be pro-active about their energy consumption and to simultaneously improve health and well-being.

Keywords: Energy use, indoor environment, health, behaviour change, awareness campaign, people-centred approach.

1. Introduction

"Buildings represent 40 % of final energy consumption, offering the highest potential for efficiency improvement and savings on energy bills [1]." This is a commonly used explanation of European Union (EU) when arguing the necessity to increase the number of buildings energy retrofits. Consequently, stricter EU regulations are introducing energy labelling and encouraging the use of smart technologies and advanced control strategies.

People often find information from their utility bills, smart meters or energy performance certification (EPC) difficult to understand or credible [2]. Oftentimes, users' behaviours do not match the design intentions as users find building technologies difficult to control since these most often do not comply with their needs and their everyday habits [3–5]. A research conducted at Aalborg University analysed 230,000 detached homes building's energy labels and their actual energy consumption revealed that occupants in homes with less efficient energy labels (i.e. G) consumed less energy than predicted by the label [6]. However, occupants in homes with best energy labels (i.e. A) were using more than predicted. As discovered, the users dictate how much energy is actually consumed, while EU legislation dictates how much this amount should *technically* be. This result

 doi:10.20944/preprints201710.0064.v1

shows there is a need to educate the users on how and why they are consuming energy since often they are not aware their behaviour results in wasteful energy usage.

The aim of the MOBISTYLE project is to increase the awareness of the users, change their habits and practices, and show that in fact, their energy usage is correlated to behavioural patterns adopted to achieve comfort at home and work, during their public and private life. The final scope of the MOBISTYLE is to offer attractive services for users and increase their understanding of what buildings and technologies can actually enable and what technology is capable of bringing to support healthy building and lifestyles [7].

Actually, the experiences from practice show that energy efficiency as such is not alone a sufficient motivating factor for all the users [8]. Therefore, a better understanding of the drivers of consumer acceptance and behaviour change in relation to energy efficiency should be developed.

2. Methodology

2.1 People-centred approach in design and development of ICT tools

In the MOBISTYLE project, the development of the ICT-based engagement platform and tools is supported by a people-centred approach, involving users as a necessary and knowledgeable stakeholder during the design and development processes [9,10]. Identification of user types (consumers) and observation of their everyday lifestyle is a prerequisite in such approach in order to understand their needs. In the first phase, the MOBISTYLE project is focusing on an anthropological observation of users, scrutinizing their level of engagement with building components, technology, energy systems and ICT tools in their everyday life.

Through different qualitative inquiries (including focus groups, interviews, and participant observation) people habits are investigated to discover their current practices, use of existing technologies, as well to investigate key factors that would trigger them to change their behaviour. The anthropological approach enables to access 'thick data', as an in-depth understanding of human behaviour, able to penetrate beyond the quantified behaviour of 'big data' collected via technological solutions [11,12]. This understanding defines requirements for developing the ICT tools in order to provide user-friendly and attractive services.

Through anthropological observations, it is possible to understand not only *how* and *when* people consume energy, but *why* do they actually do it. This additional layer of personal information opens opportunities to understand and educate users at the individual level, increasing their awareness of how and when their daily habits have an effect on energy consumption. One of the most promising outcomes of this methodology is the shift in perception from passive building occupants to pro-active users, who become co-creators of their surrounding environment.

2.2 From raw data to data-knowledge for different users groups

After segmentation of users into different groups (having certain common needs, behaviour patterns, and lifestyles) the methodological framework was developed. This is based on the key concept that occupant behaviour is a complex process, which cannot be assessed only by a single field of science [13]. In the MOBISTYLE methodology, a multidimensional systematic approach analyses the interaction between buildings, users, and energy; therefore bringing together different fields: energy and building physics, health science, anthropology, social psychology, and computer science. Figure 1 shows the four main areas developed in the MOBISTYLE methodology.

 doi:10.20944/preprints201710.0064.v1

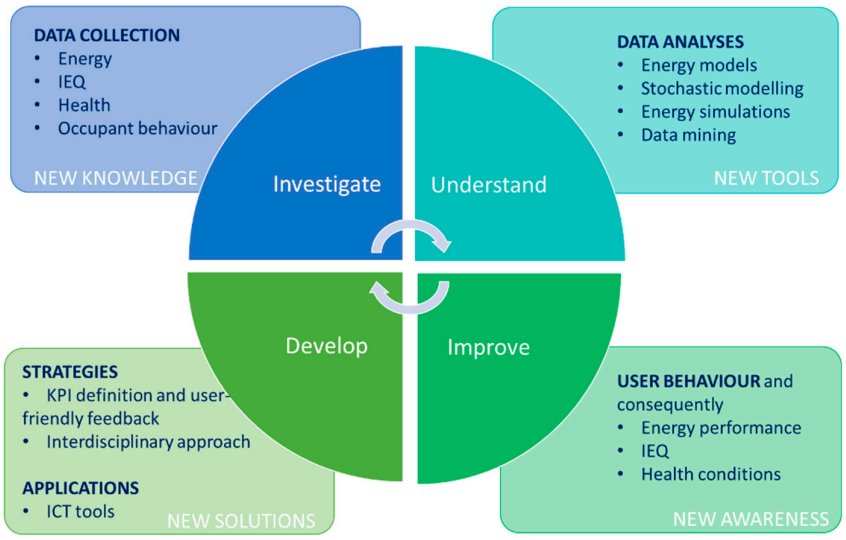

Figure 1. The four areas of the developed MOBISTYLE methodology. Adapted from [14].

The four areas shown in Figure 1 are:

1. Investigation of the operation of energy systems through behaviour-related data collection (building and user data monitoring) and monitoring of human presence and practices;
2. Understanding of the human behaviour (comfort, health) through user data analytics (from wearable sensors), stochastic modelling, and energy simulations;
3. Improvement of the building performance (energy, thermal comfort, IAQ) by integrating behavioural solutions (awareness campaign);
4. Development of strategies to transform different specific indicators into useful knowledge for the final users.

2.3 *Development of personalized ICT services*

The main idea of personalized MOBISTYLE modular information services is to offer the so called *data acquisition bundles* where users decide which services they want, for how long and during when using it, and which data they are willing to share and disclose for these services. A modular structure is developed providing tailor-made information giving a possibility to add new modules later, e.g. desire to monitor additional IEQ parameters.

The MOBISTYLE Open Users Platform will be established having an open architecture for developers engagements and for further deployment of the developed tools. This platform will focus on the implementation of the end users behavioural aspects of the solution as well as the developed MOBISTYLE standardized methodological approach (including data analysis techniques). To test the attractiveness and ease of use of developed platform and services, an engaged learning method [15] with the users at the demonstration sites is elaborated. Following the people-centred approach, it is observed how the users interact with newly developed services and test their knowledge and understanding (i.e. the purpose of usage). This usability testing is functional to prepare recommendations for improvement and further development of ICT tools.

2.4 *Continous feedback as a road to MOBISTYLE future*

The methodological approach tested during the MOBISTYLE project does not configure as a stand-alone development of ICT tools and services. Rather, it presents a long-term dynamic approach where ICT tools and services are supported and communicated with users through awareness campaigns.

The findings of an extensive literature review of experience on feedback and data display show that improved feedback on energy usage can reduce consumption up to 20 % with low capital (or

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 10 October 2017 doi:10.20944/preprints201710.0064.v1

no-capital) technology investment expenses [16,17]. The study by Hong et. al [17] shows that for both residential as commercial buildings 5 – 15 % saving can be obtained by providing direct feedback (e.g. smart meters and target settings) whereas with a combined tailored information provision and direct user control savings up to 20 % can be achieved. The MOBISTYLE project will measure, by means of real-life demonstration cases of diverse building typologies and intended usage in different cultural and climatic context, the achievable energy saving resulting from the data-driven behavioural change. The measurable quantitative objectives of MOBISTYLE is a reduction of energy use of at least 16 % prompted by combined monitoring and other consumption feedback systems on energy, IEQ, and health. By educating the users, users have a sense of control and become aware how the generated environment affects their health and well-being and how they spend their energy.

As shown in Figure 2, people are often not aware how and when they are using energy nor whether such actions lead to relatively high or low consumption, whether it is decreased or increased in comparison with their previous actions [18]. This shows a great potential for improvements where awareness campaigns and feedback features can be chosen depending on the project needs (different frequency, duration of feedback, medium and way of presentation, translation from big data to smart data, communication strategies, etc.).

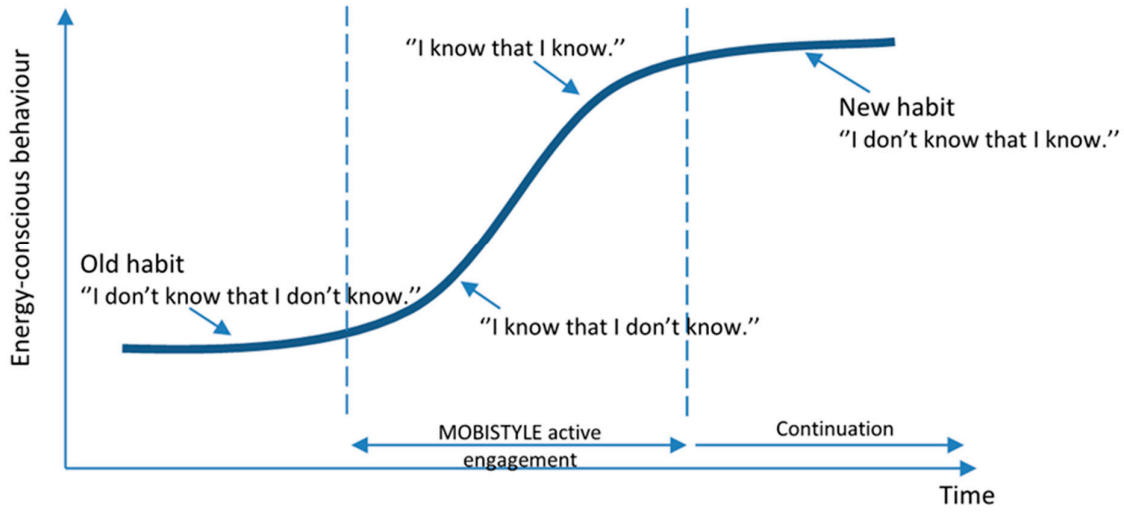

Figure 2. MOBISTYLE awareness process encouraging a change from energy unconscious to energy conscious behaviour due to the engagement with the MOBISTYLE tools. Adapted from [19].

Efficient communication and information strategies will be developed beside offering users tailor made ICT tools and services in order to assure efficient usage of the developed services. Age, educational background, social control and supervision on various levels (top-down, peer-to-peer, self-monitoring), knowledge, habits of using new technologies are powerful features influencing the use of ICT services. As an example, older people are typically driven by different reasoning factors than the younger generation. Necessarily, different communication methods need to be chosen to trigger these two groups [20]. Communication strategies are analyzed in order to find most suitable stimulating strategies that encourage different users groups to feel an emerging need to delve further and become curious about energy, health and the resulting improvements in their lifestyle. The MOBISTYLE concept is kept alike, while ways of interpreting data and communication strategies are adapted to the different user needs.

3. Results

3.1 Demonstration and validation of the MOBISTYLE approach

The developed MOBISTYLE approach and tailor-made services are validated for the five demonstration cases in real life operating conditions, in five different locations:

- Social housing apartments at Kildenparken, Aalborg, Denmark;
- University buildings at the University of Ljubljana, Ljubljana, Slovenia;
- Apartments at the Hotel Residence L'Orologio, Turin, Italy;
- Health care centre azM Herstelzorg, Maastricht, The Netherlands;
- Residential houses as part of the Smart City Wroclaw, Wroclaw, Poland.

The usability of the MOBISTYLE tools is evaluated by monitoring behavioural change for each demonstration case after 2 months, 6 months and 12 months of the behavioural change strategy implementation. Baseline was defined at the start of the monitoring phase, as any MOBISTYLE measures were implemented in order to assess users' old habits and their daily behaviour. Behavioural and building data gathered from the demonstrators and feedback from the user groups are used to adjust and fine-tune the methodologies, tools, services and supporting business models along with the project. Outcomes from the study will be used for generalizing recommendations in which the individual building users are classified in archetypes (personas), each with their own information approach and strategy to come to lasting behavioural change and motivation. For this purpose, and for each of the demo cases, a monitoring and awareness campaign is devised, that will be continued after the project duration.

3.2 *People-centred recommendations for the technology development based on focus groups*

Focus groups, supplemented by participant observation, have proven to be a useful research technique for studying users' habits, motivations, needs and expectations in the MOBISTYLE project since they allow researchers to study people in a less structured conversation pattern than typically occurs in an ethnographic interview [21]. For each demo case, one focus group involving 5-8 people users per case, was carried out. Whenever possible, the discussions were elaborated with the people in their own buildings, avoiding more formal artificial environments, such as research institute facilities, as well as Skype conversations. Questions for the participants were in one part unified for all groups and partly adapted to specific cases. In this way, the main topics of the project were discussed with users of the demonstration buildings and the MOBISTYLE common goal was discussed in different settings.

Findings from the focus groups, supplemented by interviews and participant observation have been instrumental in preparing ten key recommendations (Figure 3) which defined the boundary conditions for the further development of the ICT tools and awareness campaigns, as illustrated in the following sections.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 10 October 2017 doi:10.20944/preprints201710.0064.v1

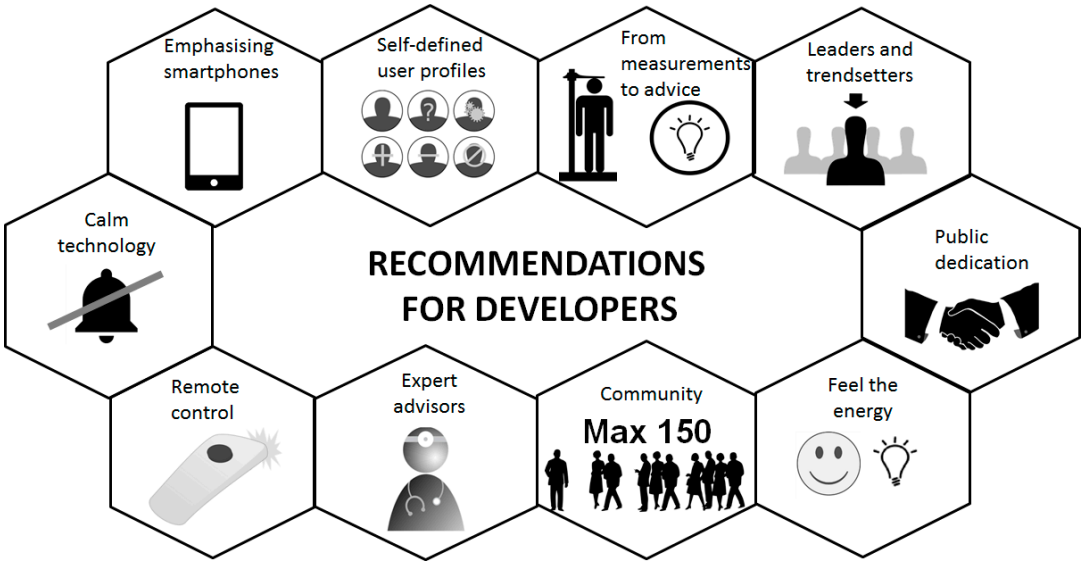

Figure 3. MOBISTYLE recommendations for the ICT developers based on the focus groups findings.

1. Emphasizing smartphones: People in focus groups preferred the usage of the smartphone as the main platform for communication between the users and the ICT tool. Smartphones are among the most widespread and accessible tools for accessing information about weather, following the local and international news, and are often used as a health and wellbeing tracker, and having become an omnipresent and indispensable part of users' identity. Because people are typically very well acquainted with the mobile phone technology, this can be used for tracking behaviours and presences, gathering people feedbacks, as well as for influencing and changing habits (i.e. with push communication).

2. Self-defined user profiles: Users should have the possibility to create their own user profiles and to set customized personal pro-environmental goals. This can give them a feeling of active participation in defining settings for influencing their own habits. Based on the selection of preference and interests, different parameters can be shown to the users. The ICT tool can be fine-tuned according to users' goals, preferences, and priorities over time, i.e. by sending an inquiry (pop-up-notification) after a certain period (e.g. one month), to see whether these are still in line with the user's requirements or if he or she wishes to reassess or change them. This adjustable self-assessment capability of the system enables a continuous opportunity for the users to actively cooperate in the creation of their own ambitions.

3. Customised and location-based advice: By combining measurements from sensors with location-based services (e.g. weather data), generic and local-specific advice can be prepared according to the local environmental characteristics. In this way, specific energy and health related habits can be supported by taking into account individuals' needs and habits when deployed in the situation of the local environment.

4. Calm Technology principles: ICT tools should not irritate the user with too frequent unnecessary notifications. Instead, the developers should rely on Calm Technology principles [22], which suggest that the most robust and reliable technologies are those that disappear and weave themselves into the fabric of everyday life until they are indistinguishable from it [22,23]. According to Case [22], the principles of Calm Technology are that a technology should require the smallest possible amount of attention, inform and create calm, make use of the periphery, be able to communicate, and work even when it fails. Finally, the technology should also take into account the existing norms in a socio-cultural environment. Out of these principles, the most relevant for MOBISTYLE users is the capability of a technology to communicate information without interrupting or distracting the users from their primary tasks [22].

5. Heating, ventilation, and air-conditioning (HVAC) and other home device controls: Ideally, the user should be able to adjust various parameters influencing his or her indoor comfort through the same ICT tool (e.g. readjusting temperature or humidity in the room or turning off the lights). This implies

 doi:10.20944/preprints201710.0064.v1

there is a need to give the user control over his indoor environment through ICT tools that are at the same connected to multiple sensors, equipment and devices from the environment.

6. Expert advisors: It is recommended to prepare communication material (i.e. short video clips) of experts (i.e. researchers, academic figures) providing advice or explaining capabilities and tasks which will be accessible via the ICT tool. There should be a possibility for deepening their pro-environmental interest and knowledge about a specific recommendation, for example by links to popular social media as well as scientific articles, connected to health, wellbeing, air quality, and energy savings. Advice should be supported by a trusted reliable source and reference as this can improve people's propensity to behave in a suggested way. The videos should be prepared or subtitled in local languages, to overcome communication barrier with users.

7. Spreading the concept through community leaders and trendsetters: When implementing the technology and approaching for changing habits, the developers should focus on early adopters, trendsetters, and influencers who are able to motivate others to use the novelty in a community. If they manage to start collaborating with them already during the development phase and include their ideas and suggestions in the ICT tool, it should be easier to motivate other users in different cases to accept it. Furthermore, popular local public figures can help spreading the main message.

8. "Feel the energy" approach: The problem related to energy saving is that energy is often impossible to be felt and cognitively processed. People are able to see the impacts of energy. However, they are unable to perceive the quantity of energy there are using in their everyday practices (i.e. increasing the heating set point of the thermostat can increase the heating energy consumption up to 7 %). Therefore, energy should be visualised in a clear and understandable way, without using standardised units of measuring energy and power. For example, the energy can be compared to daily physical activities or food consumption of an individual or a community. In this way, the designers and developers are able to combine health, wellbeing, and energy use, and make the users feel how energy is produced and consumed.

9. Public dedication to a goal: Anthropological, psychological and sociological studies show that when an individual's decision for changing a certain habit is presented to other people and to the public, this provides a strong peer pressure and stimulates a person to actually achieve a certain commitment [24]. The technology used should, therefore, enable public commitment to a goal, which has to be meaningful and relevant for an individual and a community. Social media or existing local groups in different cases can be used for this purpose.

10. Community size: Anthropologists have explained that individuals can maintain stable social relationships with around 150 friends and acquaintances at most [25,26]. The MOBISTYLE studies have led to a similar finding in practice: in buildings with less than 150 people, the inhabitants (or employees) have a feeling of a community; they meet each other and regularly communicate. However, buildings and settlements with a larger number of inhabitants witness problems of social bonds breakdown. In such cases, the developers should support establishing new communities and enable people to create new ties for helping each other and exchanging information through the ICT tool.

In addition, the focus groups provided some unexpected findings, relevant for the development of ICT tools. For example, before the studies were put in place, it was assumed that behavioural changes motivated by health-related issues rank higher on the priority list than energy-saving opportunities, which has proven to be correct. However, it was unexpected to see which elements of a healthy lifestyle are most relevant for people: food, sleeping, rehydration, etc. In addition, the research showed that social pressure and community-based support play important roles in changing existing practices and supporting healthy and sustainable lifestyles. Finally, particularities of different demonstration cases should be taken into account when adapting the general ICT tool to different cases and their socio-cultural specifics, people of different age, gender, social and employment status who live and work in different settings, locations, and buildings. Instead of 'one-size-fits-all' approach, the ICT tool should be therefore tailored to different cases and specifics of people, who should have a possibility to change and adapt the tool to individuals needs and attitudes.

 doi:10.20944/preprints201710.0064.v1

4. Discussion

Knowing individual users and finding out as much as possible about their habits, practices, and behaviour has been a crucial aspect in the development of the MOBISTYLE ICT tools and services. Identified MOBISTYLE key takeaways learned until now are:

- *Listen to the people*: The crucial role when developing user-friendly and people-centred ICT tools is understanding users, their values, and capabilities in order to develop user-friendly and people-centred tools and services that are accepted by these users. Segmentation of people into different users groups makes it possible to identify main motivation factors for behaviour change, information and communication strategies common for different end-user groups and their lifestyles.
- *Educate the person*: More transparent, tailored and easy to understand information on how user actions affect health, environment, and energy consumption is effective in changing their current behaviours. By clearly communicating the benefits of using ICT based technologies, new desire is created where the user decides to use the technologies because of the actual benefits he or she will gain.
- *Variety of communication strategies and effective feedback:* When offering tailor-made solutions to different end-user groups different communication techniques need to be adapted according to the different user groups and their social background, age, gender, provenience, etc. In addition, continuous clear information needs to be provided leading to long-term behaviour change.
- *The user should be in control*: By giving users the possibility to decide which services they want to use, for how long and during what time, creates a hassle-free sensation that enhances the users' participation and control. Technology stress reduction can be achieved, i.e. by using pull instead of push communication service, as well as allowing the user to decide which data he or she is willing to share.
- *Ensuring data privacy and security:* The users should be clearly informed on data collection, storage, usage, and protection issues.
- *Providing an added value:* As recognized from practice, energy efficiency as such is not the most effective motivation factor from end-user perspective in order to change their behaviour [8]. Therefore, instead of selling energy efficient buildings, users can be offered healthy buildings where consequently also energy efficient and sustainable behaviour is achieved. As an example, users are educated that lowering down thermostat will not just bring energy savings but can also contribute to their better well-being and improved metabolic health [27–29].

A challenge correlated to this study is the replicability of the developed approach to different user groups involving a larger number of users. After MOBISTYLE completion, a guide for replication will be devised including insights and guidelines into the anthropology-based development of technical solutions and it will be explained how to identify different effective feedback mechanisms, communication and awareness campaigns strategies for different end-user groups.

5. Conclusion

The aim of the MOBISTYLE approach is to show that improving buildings and building technologies is not enough. In order to achieve ambitious goals of EU on energy savings, a different approach is needed, where users of the buildings are equally important part of the building ecosystem as technologies. Therefore, the emphasis should be on educating users on how to behave in their buildings and how to increase their awareness by combined information on their energy usage, generated IEQ, health, and lifestyle. Contributing authors believe that with such an approach a long-term understanding can be stimulated where energy conscious and healthy behaviour becomes a way of life and not only a one-time service, noticed as energy saving at the end of the month. In addition, ICT engineers should start the development of new solutions from the people-

 doi:10.20944/preprints201710.0064.v1

centred perspective, i.e. by discussing with people (potential clients and users) what are their actual needs and expectations and how the technologies should be designed to improve their lives for the better. Finally, it should be emphasised that the people-centred development is an iterative process, which means that the developers should continuously return to users of their products or services to repeatedly ask questions that shed light on how ICT solutions meet their needs and desires.

Going further, the development of the project aims to illuminate some practical ways to transform theories, analytical methods and ICT-based solutions developed in the context of the MOBISTYLE projects into real pilot study applications. Moreover, in a broader perspective, it will deliver ground to validate and test the effectiveness of enhanced human-building interaction as the innovative energy efficient paradigm in the building sector.

This range of human-building products is foreseen as a strong support to the implementation of the Energy Performance of Buildings Directive (EPBD) and Energy Efficiency Directive (EED) regulations in the face of achieving 2020 and 2050 energy conservation goals in the European building sector. At the end of the project, it will be assessed how to integrate the developed MOBISTYLE methodology in Energy Performance of Buildings Directive (EPBD) regulations.

Supplementary Materials: Further information is available online at https://www.mobistyle-project.eu/.

Acknowledgments: This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement No 723032 (MOBISTYLE).

Conflicts of Interest: The authors declare no conflict of interest. The sole responsibility for the content lies with the MOBISTYLE consortium. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

References

[1] European Commission, EASME, Buildings. Available online: https://ec.europa.eu/easme/en/buildings (accessed on 30.05.2017)
[2] Nykanen, E.; Piira K.; Pae K.; Hildebrandt, D.; Leal, S. D3.4 - EEPOS End-Users Collaboration Tool Specification report. EEPOS: Energy management and decision support systems for energy positive neighborhoods. Project 7th Framework Programme. Grant Agreement no: 600050.
[3] Christiansen, E.; Andersen, P. V.K. Digital Living at Home - User Voices about Home Automation. SCIS: 2013; 156, 40–52.
[4] Gram-Hanssen, K. Understanding change and continuity in residential energy consumption. Journal of Consumer Culture: 2011; 11(1), pp. 61–78.
[5] Gram-Hanssen, K. Residential heat comfort practices: understanding users; Building Research & Information: 2010; 38(2), pp. 175–186.
[6] Christensen, T. H.; Gram-Hanssen, K. UserTEC - User Practices, Technologies and Residential Energy Consumption; Poster session presented at Innovationsfondens Årsdag: Odense, Denmark, 2015.
[7] Krippendorff, K. The Semantic Turn; A New Foundation for Design; CRC Press: Boca Raton, Florida, USA, 2005.
[8] Op 't Veld, P. MORE-CONNECT: Development and advanced prefabrication of innovative, Multifunctional building envelope elements for modular retrofitting and smart connections. Energy Procedia: 2015; 78, 1057–1062.
[9] Sanders, E. B. N. Design Research in 2006. Design Research Quarterly: 2006; 1 (1), 1-8.
[10] Sanders, E. B. N. Co-creation and the New Landscapes of Design. CoDesign: 2008; 4 (1), 5-18.
[11] Menzies, T.;Williams, L.; Zimmerman, T. Perspective in Data Science for Software Engineering. Morgan Kaufmann: 2016; pp. 369-274.
[12] Boellstorff, T.; Maurer, B. Data, Now Bigger and Better!; Prickly Paradigm Press: Chicago, 2015.
[13] D'Oca, S.; Chen, C.; Hong, T.; Belafi, Z. Synthesizing building physics with social psychology: An interdisciplinary framework for context and behavior in office buildings. Energy Research and Social Science: 2017; 34, 240–251.

 doi:10.20944/preprints201710.0064.v1

[14] Fabi, V. MOBISTYLE 3.1 – Detailed monitoring and information campaign parameters (objectives, data requirements, monitoring tools, information services) based on combined feedback about energy, IEQ and health. Grant Agreement no: 723032; 2017.
[15] Carrithers, M. Anthropology as a Moral Science of Possibilities. Current Anthropology 2005, 46 (3): 433–456.
[16] Darby, S. The effectiveness of feedback on energy consumption. A review for DEFRA of the literature on metering, billing and direct displays; Oxford University: 2006.
[17] Hong, T.; Yan, D.; D'Oca, S.; Chen, C. Ten questions concerning occupant behavior in buildings: The big picture. Building and Environment: 2016; 1–13.
[18] Fisscher, C. Feedback on household electricity consumption: a tool for saving energy?. Energy Efficiency: 2008; 1, 79–104.
[19] Corgnati, S. P.; Fabi, V.; Barthelmes, V. M. Task 3.1 Methodological framework for the energy monitoring campaign; Presentation at the MOBISTYLE Kick-Off meeting: October 2016.
[20] Dunbar, R. Coevolution of Neocortical Size, Group Size and Language in Humans; Behavioral and Brain Sciences: 1993; 16 (4), 681-735.
[21] Spradley, P. James. The Ethnographic Interview; Waveland Press: Long Grove, 2016 (1979).
[22] Case, A. Calm Technology: Principles and Patterns for Non-Intrusive Design, 1st ed; O'Reilly Media, USA, 2015.
[23] Weiser, M. The Computer for 21st Century. Available online: https://web.stanford.edu/class/cs240e/papers/weiser.pdf (accessed on 25.04.2017)
[24] Harvard business review. Incentives Don't Help People Change, but Peer Pressure Does. Available online: https://hbr.org/2017/03/incentives-dont-help-people-change-but-peer-pressure-does (accessed on 24.05.2017)
[25] Dunbar, R. Coevolution of Neocortical Size, Group Size and Language in Humans. Behavioral and Brain Sciences: 1993; 16 (4), 681-735.
[26] Hill, R. A.; Dunbar, R. Social Network Size in Humans. Human Nature: 2003; 14 (1), 53-72.
[27] Schellen, L.; van Marken Lichtenbelt, W. D.; Loomans, M. G.; Toftum, J.; de Wit, M. H. Differences between young adults and elderly in thermal comfort, productivity, and thermal physiology in response to a moderate temperature drift and a steady-state condition. Indoor Air: 2010; 20(4),273–283.
[28] van Marken Lichtenbelt, W. D.; Hanssen, M.; Pallubinsky, H.; Kingma, B.; Schellen, L. Healthy excursions outside the thermal comfort zone. Building Research & Information: 2017.
[29] van Marken Lichtenbelt, W. D.; Kingma, B.; van der Lans, A.; Schellen, L. Cold exposure – an approach to increasing energy expenditure in humans. Trends in Endocrinology and Metabolism: 2014; 25(104), 165–167.