MOBISTYLE

Motivating end-users behavioral change by combined ICT based modular Information on energy use, indoor environment, health and lifestyle

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Summary (abstract):

The main goal of this deliverable is to prepare recommendations for developing a new solution with potential to influence habits based on needs and expectations of people, living and working in MOBISTYLE demonstration cases, i.e. in the Netherlands, Slovenia, Poland, Italy, and Denmark. Information provided in this deliverable serves as orientation for partners in the project who will be developing solutions for influencing user behaviour and supporting a long-term shift towards healthier lifestyle and sustainable habits at home and work. Results of this deliverable can be therefore used for designing a solution for supporting **a move from being a passive user of buildings and technologies to being an engaged person,** who is concerned about health and wellbeing, and at the same time a sustainable community member, who takes care about energy consumption.

This report is partly based on *D2.2. Inventory of user needs and expectations* and upgraded by findings from focus groups, interviews and information received from users in five countries. In previous tasks and deliverables, we have already confirmed that technologies (e.g. smartphone apps) can influence behaviours and beliefs of people and help shaping their long-term habits and practices (see D 2.2). In addition, it has been demonstrate that connections to other people, living in the same community, matters the most in forming and changing daily habits and practices, including the ones connected to energy management, health, and wellbeing. A balance between collaboration and competition has also proven to be an important factor for the MOBISTYLE project.

Questionnaires, focus groups, workshops and observations carried out in the frame of MOBISTYLE project, formed a foundation for framing recommendations to develop the technological solutions. The recommendations are divided into two sections: general recommendations and case-specific recommendations. The ten general recommendations can be applied in all cases, while the case-specific recommendations take into account requirements of people in different locations and buildings.

General recommendations:

1. **Emphasising smartphones:** using a smartphone as the main platform for communication between the user and MOBISTYLE solution.
2. **Self-defined user profiles:** enabling a possibility for the users to actively cooperate in creation and setting-up of their own profiles.
3. **Customised and location-based advices:** providing advices, adapted to users and their local environment, which are based on sensor measurements.
4. **Calm technology principle:** new IT-based solutions should not irritate the user with too frequent notifications; instead, they should support their habits from the "background" (with minimal cognitive load).
5. **Building systems and other home device controls:** users should be able to adjust various parameters influencing his or her indoor comfort through the same IT-based solution.
6. **Expert advisors:** people trust human experts (medical doctors, energy professional, air quality experts) providing them advices.
7. **Spreading the concept through leaders and trendsetters:** when spreading the new motivation concept, it is worth focusing on early adopters and trendsetters who will engage others to use the IT solution in a community.
8. **"Feel the energy" approach:** making energy more intuitive by connecting it to a physical activity or lighting as a primary association when referring to energy.
9. **Public dedication to a goal:** when an individual's decision for changing a certain habit is presented to other people, a person is more motivated to stick to a certain commitment.
10. **Community size:** buildings and settlements with larger number of inhabitants (above 150) witness problems of breakdown of social bonds; in such cases, the IT solution should support establishing new communities and creating new ties for exchanging information.

Key words:

ethnographic study, people-centred product development, user needs, changing behaviour and habits

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1. Introduction

In the MOBISTYLE project, we **shift our focus from buildings and technologies to people with their behaviour, habits, and practices.** We wish to understand how people interact with buildings, tools and devices at home and at work, how do they consume energy throughout the day, and how we can change and influence their practices and habits by supporting technologies and non-technological means. Therefore, we use **ethnography** as a type of research that investigates daily lifestyles, habits, and practices through qualitative approaches (e.g. participant observation, interviews, focus groups, etc.). These approaches enable us to gain an in-depth understanding of human behaviour and penetrate beyond quantified behaviour of "big data", collected by technological solutions. Ethnography also provides an alternative to quantifiable surveys, questionnaires and other similar approaches for *measuring* human activities. In the MOBISTYLE project, we use ethnography to understand why and how people consume energy in a certain way, why are they involved in healthy practices, how do they manage air quality at home and work, and what are the main motivation factors for them to make a shift in their daily lives to a healthier and more sustainable lifestyle.

The **aim of this report** is to present health and energy related habits in five MOBISTYLE demo cases: a neighbourhood in Denmark, a smart city in Poland, a university in Slovenia, a hotel in Italy, and a medical centre in the Netherlands. The findings from these diverse cases are used to prepare recommendations for development of MOBISTYLE solution and should be tailored and adapted in collaboration with engineers and other experts to different scenarios, specifics of buildings, and identified energy use possibilities.

As explained above, **people are in the centre** of the MOBISTYLE project. Therefore, we prepared recommendations for development of new IT solutions in collaboration with the people (sometimes referred to as "users" or "consumers") and take into account their needs, requirements, specifics, wishes and desires, socio-cultural and economic backgrounds, etc.

1.1 Methodology

In the MOBISTYLE project, we focus on human interactions with buildings, technologies, tools, and devices at home and work. We are interested how people consume energy throughout the day, which daily activities of the people are connected to health, wellbeing, and energy consumption, and how we can change and improve their health and energy related practices and habits by different IT-based solutions. (The research approach and methodology used is described more in details in *D2.2. Inventory of user needs and expectations*.)

In this project, we use the human or **people-centred development approach** that enhances effectiveness and efficiency of products and technologies, improves user satisfaction, accessibility and sustainability, and counteracts possible adverse effects of use on human health, safety and performance. The people-centred approach focuses on actual needs of humans („users") and attempts to include their habits, practices, ideas, desires in new products and services. The result of such a development approach is people-friendly and intuitive solutions which are relevant from a broader perspective of communities, societies, and environment.

Different user groups were initially identified by a short **online survey**, filled in by users in five case studies. We identified 5-7 individuals per case in participating countries with dedicated demonstration cases, i.e. 30 people in total, who were willing to be engaged in observations of their daily habits and usability testing for development of new MOBISTYLE solution (see D 2.2 and *Table 1* below). In the next phase, we focused on **health, wellbeing and energy related habits** in these groups by ethnographic approach (participant observation, interviews, surveys and focus groups). Finally, we prepared a **list of general and case-specific recommendations for development** of technological solutions which will influence short-term behaviour of the people and support establishing the long-term habits connected to health, wellbeing and sustainable energy use.

In later stages of the MOBISTYLE project, we will introduce in the WP4 developed solutions to potential users, involved in the project, and carry out usability testing with them to provide feedback to the developers.

2. Focus groups

For each demo case, a focus group with the existing or future users was carried out. The selection of participants was carried out by the project partners, following the *Recruitment of participants in the ethnographic study Instructions* as described in D2.2. Before each group discussion, the participants were informed and gave consent regarding the data collection (recording and analysis) and expressed their interest to participate in the project also in the future. Questions for participants were in one part unified for all groups, and partly adapted to specific cases. In this way, we tried to cover the main topics of MOBISTYLE and emphasise its common goal and at the same time take into account the local specifics of cases. By this approach, we were able to frame the general and case-specific recommendations for development.

Focus groups are commonly carried out by face-to-face communication. Due to specifics of the project (five demonstration cases in different countries) we decided to carry out the focus groups by teleconference system (Skype), which presented a minor obstacle for establishing a personal contact with people. A bigger obstacle was a linguistic barrier in most case studies; we needed a local translator (a MOBISTYLE team member). In spite of these difficulties, we managed to carry out the planned focus groups in all cases and established the contact with future users of the MOBISTYLE solution. The findings have proven to be instrumental for preparing the recommendations, presented in this document.

2.1. Danish demo case: neighbourhood Kildeparken

The focus group with 8 participants (plus 2 researchers and 1 researcher / translator) took place on 21st March 2017 using teleconference system.

Participants of the focus groups were quite **diverse** – young and old (however, majority of them were men). They initially mentioned choosing and eating good food (especially vegetables), taking care of air quality, and being active as examples of **healthy habits**. A participant also mentioned socialising with others, e.g. meeting other people and eating well together with other community members, especially in their community house. *"I like to have fun in my life,"* explained another participant who enjoys good food and rides a bicycle for fun. He also added that a person should do things she or he likes to do, since it is the most important for staying healthy. In addition, regular cycling, playing soccer, running, and drinking enough water (instead of soft drinks) were also mentioned in the discussion as examples of healthy habits. It was more difficult for the participants to pinpoint their **energy related habits**. They mentioned, for example, chopping wood on their own, which can be considered both energy and health related habit.

Both health and energy related habits were, as explained in the focus group, usually established by **top-down support** and pressure of parents. Another relevant factor for establishing and changing habits is **social and cultural environment**, which enables people to maintain a certain lifestyle. An example was provided by a retired participant of the discussion who was raised in Greenland and has always walked, since it was more or less the only option for making a move. Apparently, **children and their school and kindergarten** play an important role in this community. As explained in the focus group, children bring home new ideas about health, wellbeing, and energy related topics.

Why and how do people change their habits? **Finances** seem to be an important motivating factor for reducing energy in this group. Interestingly, another relevant factor is **environmental consciousness**. A mid-aged participant emphasised: *"I have children and I have begun to think about foundations for the next generations."*

Cultural diversity seems to be a challenge for establishing common habits in this community. *"The Muslims often think that we put pork in everything, so they don't want to come to things we hold with the food,"* explained a participant in the focus group. There are some activities connected to cultural background, which seem to be odd to some locals living in community. For example, there are people originally coming from African countries who *"put carpets in front of their windows".* In their explanation, lack of ventilation causes humidity problems and makes damage to buildings.

Technologies used by participants of this case study are quite basic. Some of them use devices to measure their blood pressure. However, most of them have and use smartphones and some of them specified the Samsung's S Health app, which is used more for fun than as a serious motivation tool.

2.2. Polish demo case: smart city Wroclaw

The focus group with 6 participants (plus 2 researchers) took place on 12th April 2017 via teleconference.

"I spend most of my life at work and during a weekend I go to mountains," was the first answer to the question about **healthy habits** the participants have. Once more, health related habits were mentioned as being more relevant for participants and they were also mentioned more often in the discussion. Afterwards, other participants also stressed the relevance of physical activity. In addition, healthy diet was a relevant topic in the debate. People take care that their food is ecologically produced and that it includes a lot of vegetables.

It was more difficult for participants to pinpoint **energy related habits**. They initially mentioned switching off lights and then strayed away in the debate to renovating houses by insulation and multi-layered windows. Interestingly, they emphasised differences between age groups. In their words, elderly people keep their windows open, because *"they want to see more than on television"*. Mid-aged people spend most of time at work, while the young and old ones spend more time at home, which makes them more relevant for establishing and changing energy related habits at home.

In this group of users, **electricity bills** are a very important motivation factor for changing energy related habits. A problematic case are multi-family houses (e.g. blocks of flats) where in words of a female participant *"everyone does whatever they feel like"*. However, at the end of the year everyone gets really upset when they receive their electricity bills.

Environmentally responsible behaviour was also a relevant topic in this focus group. For example, a female participant who lives in a block of flats with her partner and two children explained she tried to motivate other people in the community to recycle waste more often. However, instead of accepting her suggestions, they started to see her as – in her own words – a *"crazy person"*. Explanation of her neighbours' is that *"it does not matter"* if people recycle waste or switch off lights

in corridors. Therefore, the mission should be to *"teach older people"*, she explained, since they have different habits which might be connected on one hand to the "tragedy of the commons" (*our comment*) and on the other to social and political system (socialism and communism) which emphasised collective goods and shared responsibility (*our comment*).

Since people in the focus group were closely connected to the project partner Tauron, they knew much more about sensors and **technologies for saving energy** and supporting energy related habits. They mentioned relevance of constant and immediate feedback, which motivates them to reduce energy bills. Technologies for supporting health related habits were less popular in this group. One participant uses a smart wristband for measuring physical activity – no other participant has this kind of device. However, Samsung's S Health app was once more mentioned as a useful tool for measuring physical activity. They even set their daily goal to 10,000 or 7,000 steps and try to follow it in their daily lives. The app motivates them to commute on foot between home and work and to use stairs instead of elevator in buildings.

Comparison to others is also an important motivation factor in this group. The participants mentioned they would like to regularly compare their activities to others, especially if there is a certain award after an achievement is accomplished (e.g. 10% salary raise, reduced electricity bill …) In addition, people are curious what the others are doing. They wish to improve **communication with others in their community** and share energy and health related tips. However, this community of "our" people should be of an appropriate size – not too big and not too small. A female participant explained that 15 apartments (approx. 60 people) is in her opinion a cognitive limit for keeping communication and establishing shared values.

In this group, **children** were mentioned to be an inhibiting factor in making change towards more sustainable and healthier lifestyle. It was explained by the participants it is difficult to change habits when you have small children due to their biorhythm.

An additional relevant comment was connected to desired technologies for promoting healthier and more sustainable lifestyle. A **refrigerator of the future**, for example, should know its contents and suggest which food and drinks would be most appropriate for users' dietary preferences. At the same time, the device would support health and energy related habits.

2.3. Slovenian demo case: university buildings

The focus group with 7 participants (plus 2 researchers) took place on 13th April 2017 in University of Ljubljana, Faculty of Chemistry and Chemical technology and Faculty of Computer and Informational Science (FKKT and FRI).

Movement and food were emphasised as the main factors of **healthy lifestyle**. In addition, biorhythm was also mentioned as an important aspect of healthy lifestyle. A computer expert mentioned in the discussion that he felt much better if he did not work during the night. Another aspect of health and wellbeing is a calm life without stress, which was confirmed by all participants. One of them said: *"Life can be interesting without that kind of stress that someone is above you all the time, telling you what you have to do".*

Defining **energy related habits** is again more difficult for the group. A participant mentions that *"synchronising transport"* is such a habit – it means that a person could use a bicycle instead of a car to catch a bus to work. The debate was focused a lot on washing and drying clothes. *"If we would wash by hands, we would definitely wash less,"* mentioned a female participant in the discussion. Another habit, which is self-evident for participants, is turning off lights. However, that habit disappeared by those who live in a student apartment with fixed costs where saving energy does not make much sense from economic point of view. Participants also mention non-economic motivation factors. One of them even said: *"I do it* (save electricity) *on principle, not because of money, since I know that one light doesn't mean anything."* At home, they pay four times as much for telecommunication than for electricity, and he still tries to motivate his children to reduce energy consumption – even by switching off lights if they don't need them. Some of them also take care to unplug devices while they are away or when a phone, for example, is fully charged. Interestingly, all participants of the focus group perceived electricity at home and work as energy and **didn't mention heating**.

Motivating factors for changing energy related habits are in this group quite diverse. However, the two main motivators are savings and environmental responsibility. What is especially interesting and relevant is that people keep their old habits when they move from an old building to new one. The participants kept many habits, including ventilating room and opening windows in offices, even is the new "smarter" building of FKKT and FRI. This was reported during the focus group and validated on building´s SCADA-based control system.[1]

Shared values and activities are very important for changing health and energy related habits. The discussion shows that different agreements and pacts (e.g. to prevent swearing and support running or energy savings) could be important to change the way individuals behave.

Participants of this focus group find different **technologies** that try to influence their habits *"silly"* (the word was used by a participant). They understand different apps and wearables as a sort of a *"game"*, which does not make much sense in their lives. In addition, some of them say they don't need a device which tells them about their own bodily parameters, since they can listen to their own body. Some of participants actually bought smart watches and wristbands and stopped using them. Another relevant finding from this debate is that **different age groups require different motivators** – as they mentioned, health is not a relevant motivator for young ones, while environment might be more important for them than for older people.

[1] All windows have sensors and ventilation regimes for each laboratory are recorded. In the old building, if there was a need for additional ventilation, they opened all windows. In the new one, this is not necessary; in fact it is even harmful, due to mechanical ventilation and the need for maintaining necessary pressure differences.

2.4. Italian demo case: a hotel

The focus group with 6 participants (plus 2 researchers) took place on 31st May 2017 via teleconference.

Eating good food and drinking wine were mentioned by the Italian focus group as **healthy habits**. In addition, the group of six women who joined the discussion, mentioned sport activities as an important habit which keeps them healthy. In this category they mentioned 30-minute daily workouts and going to work by bicycle instead of using a car. An interesting habit, mentioned in this part of the discussion, is also *"not working"*, i.e. relaxing and enjoying leisure time.

In a part on **energy related habits**, switching off lights was again the first association of the group members. In addition, they mentioned saving water and energy when using a dishwasher, for example setting it correctly when it is only half-full. Recycling paper, collecting waste, and using stairs instead of elevator were other habits which could save energy – according to the discussants. One participant emphasised that she uses stairs instead of elevator because of health aspects and not because of energy savings. Paying attention to **air-conditioning and heating** was also mentioned in this part of the debate – especially in relation to hotel guests. As it was explained, the temperature in rooms is set to a fixed temperature and the guest have a possibility only to change it in range of 3 degrees which makes problems and misunderstandings. A participant suggested that providing **written suggestions and explanations** in the rooms might be an effective way for promoting reduced energy consumption – in addition to existing "save the planet" signs.

Influencing habits of the hotel guests was another big topic of the discussion. Simple non-technological means (for example flyers) had proven to be efficient tools; however, the participants believe that they should be strategically placed, e.g. close or even on the AC remote control. An interactive IT solution which would communicate with the guest would be another important possibility to influence the people. As it was explained in the debate, **all guests are not the same** – their cultural background often dictates and defines their habits. Foreigners (non-Italians), for example, don't want their rooms to be constantly cleaned. In addition, many of them set the AC to lower temperatures, while the Italians just set it to "dry". Manager of the hotel gave an example of guests who complained about room temperatures and try to set it below 20 degrees, but could not do it, since the temperatures are pre-set. In addition to room temperatures, WiFi is another technology which the guests complain about the most. Participants of the debate do not use many **technologies and devices for changing and supporting their habits**. One of them uses a smartphone app (Runtastic) and another app for skiing. They also mentioned the reason for avoiding the technologies: an additional and unnecessary cognitive overload.

2.5. Dutch demo case: a medical centre

The focus group with 9 participants (plus 2 researchers) took place on 27th June 2017 via teleconference.

"Exercise, eat well, and sleep well," was the first reply to a question on **healthy habits** in the group. The participants also mentioned the relevance of balance between work and leisure. The balance can be achieved, as a female participant explained, by gardening and chatting to other people in the community. Regularly cycling to and from work is another approach, which makes people in the group feel good. However, this activity depends on the distance between home and work – if they should cycle more than half an hour to work, they use other means of transport instead. The participants also try to be more physically active at their workplace and sit less, which is apparently a bit easier for medical staff, e.g. physiotherapists, who don't sit as much as other workers and don't spend so much time in their offices. Another element of health, which is relevant in the medical community, is **having a proper sleep and rest** instead of just "power naps" during a tight schedule.

Energy related habits were again more difficult to pinpoint. A participant mentioned that using sunlight instead of lights is a habit, which is beneficial to save energy and improve health. The discussion then lead to overcoming depression of patients by using daylight and artificial lights (photo-therapy). Saving money was again a relevant motivation factor for establishing **energy related habits**. Parents who instructed their children to switch off the lights often supported these habits. (A participant commented that he listened to the parents and switched off the lights, since he liked to play with buttons / switches.) Peer pressure was an important motivator for establishing **health related habits.** A female participant stressed that the social media is a big pressure for her, since people show their bodies on photos and brag about their fitness, which made her want to appear like that in "public". Another male participant explained he was motivated by his son who constantly wanted to play football.

A debate about **technologies supporting their habits** was quite interesting and relevant for the project. A male participant mentioned that he regularly uses a scale for checking his weight. He motivates himself by watching online videos and DVDs with fitness trainings. However, the participants **didn't use smart watches or wearables**. However, they use these devices (Fitbit) for monitoring activities during physiotherapy. All participants in the group have a **smartphone** and most of them (6) have a health and fitness app on their phones (Runtastic, Runkeeper). In addition, they also mentioned a HelloFresh app that is used to support healthy food delivery and eating. A **smart refrigerator** which would support health related habits sounds interesting to the participants; however, they would prefer to get advice from actual people. A **technology by itself is not a good motivator** – it has to be linked with self-discipline and the habit should be supported by other people.

3. Main findings from the previous studies

In the frame of this project and work package, several research activities were carried out prior to the focus groups. Most of the previous findings are described in D 2.2. and we present here only the key findings from each approach. Pilot ethnographic studies were made at the University of Ljubljana building (focus group) and additional two workshops, both carried out in the UK: the first one at University College London (UCL) and the second at Durham University's International Women's Group. We collected additional information about the users with an online questionnaire and with an experiment in MOBISTYLE project team where we created "personas".

3.1. Preliminary focus group at University of Ljubljana

18th January 2017 at University of Ljubljana, Faculty of Arts, Slovenia. Participants: students, teacher, technical staff (5 participants).

Key findings:

- Energy efficient behaviour is habituated and often transferred from generation to generation („mentorship" principle – parents, teachers, older colleagues, etc.).
- Negative motivation: not simply making activities pleasant (gamification principle), but also making an activity unpleasant (e.g. using an elevator).

3.2. Workshop at UCL

8th February 2017 at University College London, UK. 12 participants in total, students (bachelor, master and PhD) from the Anthropology Department of UCL. The participants' age ranged between 20-30 years, varied socio-cultural backgrounds (coming from different countries). A detailed analysis is available here.

Key findings:

- „Appified" lifestyle (students use smartphone apps for tracking health related habits).
- Sport-related habits are more likely to be supported by some kind of technology (mainly apps).
- Sleep and nutrition are the categories oh habits where the participants might not use a tech support but were open on using in the future.
- Smartphones used as assistants for supporting existing habits (e.g. meditation, keeping in touch with family, supporting sport-related activities).
- Wearables are not very popular in the focus group.
- The most frequent barrier that the participants face is related to lack of time or scheduling issues. The great majority used some kind of tech support to battle these issues (mainly apps).
- Mental-related barriers (e.g. anxiety, forgetfulness, stress, laziness) were also frequently supported by technology (e.g. wearables, apps).

3.3. Workshop at Durham University's International Women's Group (IWG

Participants: a group of women with various socio-cultural backgrounds, i.e. coming from China, U.S., Sri Lanka, Australia, Czech Republic, Jordan, U.K, etc. (12 participants).

Key findings:

- IT solutions for supporting health and energy related habits are used much less than in the first workshop (UCL),
- health is an important factor for changing practices and behaviour (more than energy),
- existing habits, related both to health and energy use, are culture-specific ("brought" from original places where participants lived before moving to the UK),
- health and energy related habits are often connected to family lifestyle and not only to individuals (e.g. cooking, daily walks in nature, cycling),
- needs and expectations of participants are also often connected to improving their time management.

The workshops in Slovenia and the UK demonstrated that people perceive several other practices – in addition to sport – as being healthy, for example eating healthier, letting fresh air in rooms, and having an afternoon stroll with their family members.

3.4. Online questionnaire

We used an online questionnaire to collect additional information about people who are in the focus of our study, i.e. the people who were later involved in focus groups and who would test the new solution in later phases of the project. We prepared a short online survey and distributed it among 31 identified participants in five case studies of the project. In this way we wanted to find out more about their attitude towards healthy, energy, comfort and technologies, before we talk to them in focus groups and interviews.

Informed consent

In all studies (group and individual), the informed consent as described in Report on Ethics was obtained. It was included in emails (text and attachment) send as blind copies to the identified participants. Also in future informed consents will be devised each time when MOBISTYLE will interact with the users and will aim to gather any personal information from them.

Results of the online questionnaire inputs

Almost half (14/31) participants live in residential apartments and another 6 in multi-family buildings. Only 1 person responded to be living alone, 7 responded to be living with another person (5 NL and 2 DK case) and 12 reported to be living in a household with 4 or 5 people (7 SI[2], 2 DK and PL and 1 NL).

[2] Mostly students.

Energy management

12/31 respondents manage energy consumption at home. It was explicitly stated that energy management at home is done by male household member in 14 and by female in 7 cases out of 31. 12/31 respondents do not know who manages the (daily and financial) energy consumption at work or in their institution. A majority (9/12) of **people who manage energy at home feel neutral** there; however, they do not feel so at work (2/12).

Wellbeing and fitness

From this answer we found out that **almost all the responders are physically active** at least weekly (29/31), 13/31 even daily (Figure 1).

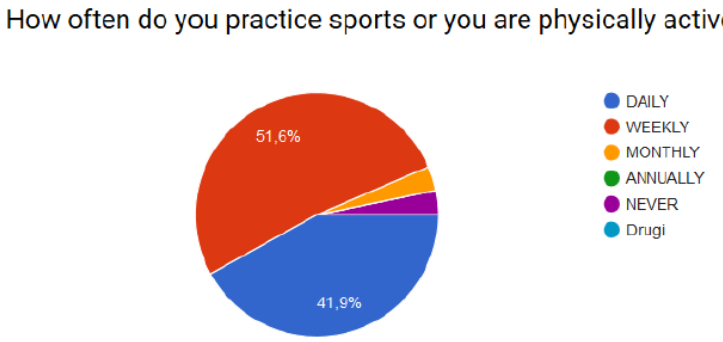


Figure 1: Shares of physical activity frequency (n=31)

Thermal comfort

A majority (20/31) often feel neutral. **Colder (-)[3] feel 4 participants from NL and PL case** (each) and only 1 from each other case (SI, DK, IT). **Warmer (+)[4] feel 5 people from SI** case and 1 from Pl and NL case.

A majority (18/29) feel neutral at home. 23/29 feel neutral if taking in to account also slightly warm and cold. 2 responded, that they feel cold at home (PL) and additional 3 slightly cool (2xNL, 1x PL). Similar to 4 feeling warm and 2 slightly warm. **4/6 people feeling warmer (+) are from SI**.

Wearables

A **wristband** for supporting health related habits (sport, recreation, walking, hearth-rate, etc.) is used only by 4 participants (TomTom Go 2 cardio, Polar with heart-rate monitor, I-phone and Xiaomi Mi Band 2 with heart-rate monitor): 3 from NL case and 1 form PL. A **smartwatch** is used by 4 respondents (TomTom go 2 cardio with heart-rate monitor, Withings Activite, U8 with heart-rate monitor and MISFIT): NL, SI and IT case.

Smartphone apps

Smartphone apps are more commonly used: 15 respondents reported to be using apps and mobile phones in their daily life.

[3] -3 Cold, -2 Cool, -1 Slightly cool
[4] +1 Slightly warm, +2 Warm

3.5. Creating personas

Personas are fictional characters which are created to represent the different user types that might use a certain product or service and represent one of the initial layers of information that results in recommendations for developer in this report. Creation of personas was used with the goal of informing the project team about the people-centred approach and bringing common understanding to the project consortium and making the team familiar with the user. These were starting point for user cantered solutions development.

The process of creating personas is described in D 2.2. The personas (for examples see Figure 2) were created on a MOBISTYLE workshop that took place on 14th and 15th February 2017 in Amsterdam and are presented in *Table 3: identified user type by the different methods.*

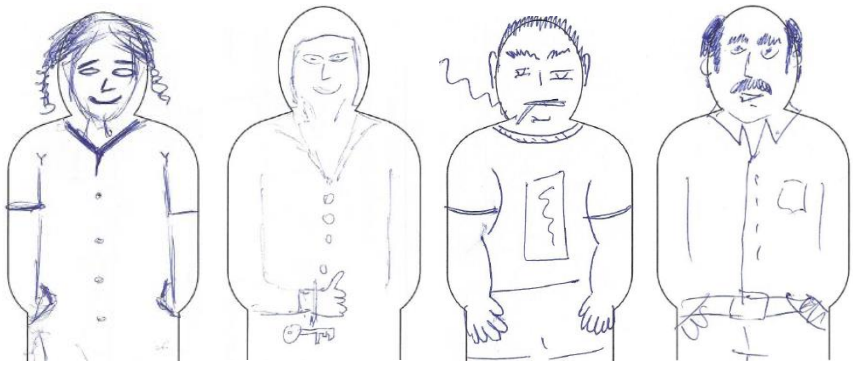


Figure 2: Visual representation of various personas created in the workshop

Key findings

Almost all health-related habits, described in "personas", are connected to **sport activities**, e.g. running, walking, etc. Only two put on top of their priority list the **healthy and home-made food**. Some of them, especially elderly people, do not use apps and rely instead on conventional media. **Smartphones and wristbands** seem to be the most relevant technologies for supporting health, while the **thermostat** remains the main technology for managing energy at home. According to "personas", women are more likely to use calorie counters – **losing weight** seems to be an important motivation factor for influencing their habits and practices. The biographies, characteristics and traits of the "personas", constructed at the workshop, were **rarely defined in relation with others**, e.g. how do other people interact with them and perceive them; the "personas" were also depicted as single, "atomistic" social units. In fact, however, people constitute their social identity – and also habits and practices – in connection and relation to others.

Table 1: Identified user type by the different methods

WP3 data collection[5]	Case study participants[6]	Personas created	Focus groups participants
Slovenian case			
students	Student 4x	A student of the university	Student 2x
technical staff	Head of group, engineer	A member of the technical staff	Maintenance Safety Care taker
teaching staff	researcher		Professor Teaching assistant
administration	head of department		
Dutch case			
physicians	Physician, PhD	Physician	
nurses	Coordinator coach sport and research Family coach in pedagogic	Nurse	Nurse occupational therapist personal healthcare assistant physiotherapist
managers	Care coordinator	Building manager	
cleaners		Cleaner	housekeeping employee
Patients		Patient	Patient
	Researcher "Onderzoeker" PhD candidate		HR officer
Italian case			
guests	Guest	Long term guest	
staff members	Cleaning lady Reception 2x	Cleaning staff	Cleaning staff Reception 2x
managers	Manager	Manager	Manager
Polish case			
residents	Specialist	20-30 years old	Apartment 3 persons (small child) Detached house 4 people (2 elders)
	Project Manager	30-40 years old no children	Bloc of flats 3 persons (small child) 2x Individual house 4 people, 2 small children
	student + trainee Student Engineering specialist R&D Expert	30-40 years old with children 40 + years old	

[5] WP3 data obtained from "Case studies definition" WP3 online on 1st February 2017.

[6] Own definition in the questionnaire.

Denmark case			
residents	pensioner Taxi driver Unemployed Student / company owner	Old retired couple Single mother with children Student Young male professional	Retired couple Retired Caretaker and their boss Housing developer 2x

4. Recommendations for developers

Analysis of questionnaires, focus groups, workshops, creation of personas, and other people-centred approaches, carried out in the frame of MOBISTYLE project (findings published in previous deliverable D 2.2 and in this deliverable D 2.3), has revealed some relevant and unexpected findings which we will be able to use in development procedures. The first and the most important finding is that the potential users of MOBISTYLE solutions are in their daily lives **most focused on health and wellbeing and they put energy related activities on a less prominent position**. Health and wellbeing is in their opinion a much broader category than just physical activity. For example, they emphasise food, cooking, having fun and sleeping as important elements of a healthy lifestyle. Habits and long-lasting practices, such as we intend to support in the MOBISTYLE project, are formed in communities, neighbourhoods and circles of friends through peer pressure in offline and online social networks, and in families and educational institutions by "top-down" supervision and control. Therefore, we should stress the **collective and collaborative factors** when developing a new solution and make a move from influencing, changing and improving individuals' behaviour.

The recommendation for MOBISTYLE solution development are provided below, where each recommendation has a cross references to justify it. The known technical and user-based limitations were taken into account as much as possible. However, before the development process begins, they need to be distilled and upgraded with the rest of development team, including energy and health experts.

The recommendations are divided into two sections: general and case-specific. In the first part, we provide recommendations for development of technologies, which can be applied in all cases (Figure 3). In the second part, we provide recommendations for adapting the general solution to different MOBISTYLE cases and we take into account requirements, needs and specifics of people living and working in different settings, locations, buildings, and socio-cultural environments.

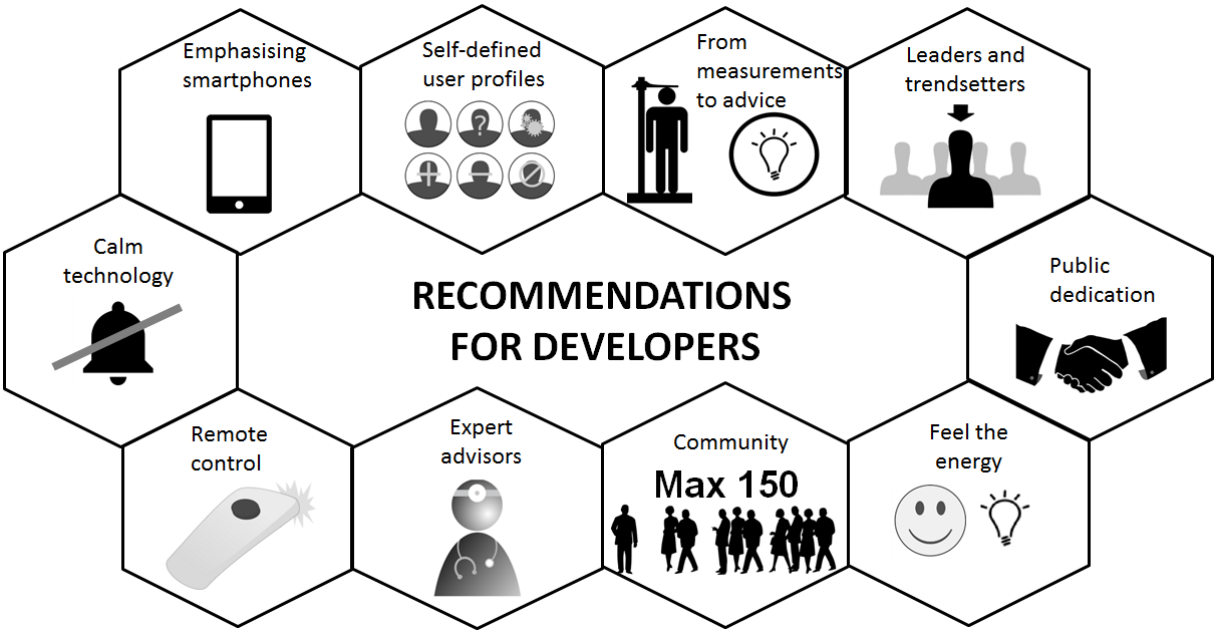
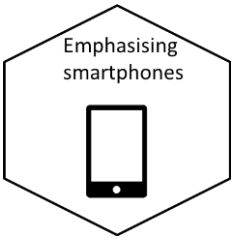


Figure 3: Visualisation of general recommendations

4.1. General recommendations

1. Emphasising smartphones



We recommend **using a smartphone as the main platform for communication** between the users and the MOBISTYLE solution. The smartphone can be used for enabling them to change the settings and influence their surroundings, e.g. changing room temperature, making decisions about temperature trainings, deciding about health-related activities, etc. Smartphone technology is most widely adopted among our users and is much more popular than, for example, smart wristbands and watches. A smartphone is the main tool for accessing information about weather, following local and international news, and is also often used as a health and wellbeing tracker. (Especially popular among our users is, for example, the S Health app, which is a default app in new Samsung smartphones[7]). The smartphone penetration in Western Europe is ~ 65% and is growing [2]. If we focus our product only on wearable technologies with low market penetration rate (globally the in 2017 137.8 million units[8] compared to ~1.500 million smart phones sold in 2016) [4], usability of our solution will be limited and implementation in demo cases will be more difficult and technically challenging. We cannot assure the users would buy a certain wearable only because our solution is based on it. In addition, people are already used to the mobile phone technology: a smartphone has become an omnipresent and indispensable part of users' identity, and can be therefore used in our project on one side for tracking and on the other for influencing and changing habits.

2. Self-defined user profiles

Users should have a possibility to **actively cooperate in creation of their own user profiles**. This would give them a sense of active participation in defining settings for influencing their own habits. In addition, we will get to a more personalized user experience. A suggested initial question for the users of the new IT solution can be connected to what is most relevant for them and what are the main motivation factors for making lifestyle changes:

- **food**: healthy diet is perceived by the users as the main – or at least very important – heath influencing parameter,
- **movement**: outdoor activities have demonstrated to be a relevant and desired lifestyle element which influences people to change their existing habits,
- **savings**: correlation between saving energy and money is well known and widely accepted by our users; savings are an important motivation factor also because one sees the impact soon, while on the contrary it takes longer to see implications of individuals activities on global climate preservation,

[7] Samsung has globally the highest market share (over 20%), in Europe even more [1].
[8] In the first quarter of 2016, the top-selling wearables brands were Fitbit (with 4.8 million units shipped), Xiaomi (3.7 million) and Apple (1.5 million) [3].

- **environment**: some users emphasise relevance of environmentally responsible behaviour; however, they are focusing more on local pollution, e.g. by PM_{10} micro-particles that directly affect health; the research has shown that people care about the global environment and understand dangers of climate change, however, they usually don't change their habits and reduce their emissions of greenhouse gasses only due to environmental threat.

Based on the selection of preference and interests, different parameters can be shown to the users. After a certain period (e.g. one month), the IT solution could inquire again if this are still the users' goals, preferences and priorities or if they wish to change them.

3. Customised and location-based advices

On the basis of advices that will be created and referring to health (or what is unhealthy according to WHO [9] or a ASHRAE criteria for comfort) and productivity, the users prefer to be "pushed" on the basis of measurements (location dependent) from the "project-included" sensors (buildings and wearables) and also based on preferences and mobile device integrated sensors such as lighting, accelerometer, noise…. By **combining measurements from sensors with location-based services** (e.g. weather data), adjustments for different cases can be prepared in addition to general advices. In this way, we will be able to support certain energy and health related habits by taking into account individuals' needs and habits and also a situation in local environment.

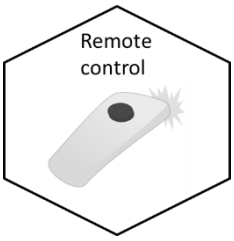
4. Calm technology principles

The IT solutions, prepared in the project, should not irritate the user with too frequent notifications. Instead, we recommend using the **Calm Technology principles**,[10] which suggest that **the most profound technologies are those that disappear** and weave themselves into the fabric of everyday life until they are indistinguishable from it [5], [6]. Out of the eight principles, the most relevant for our users is the one which explains that when designing a technology, we should strive to communicate information to the user without interrupting or distracting them from their primary goal [6].

[9] WHO defines what is unhealthy what represents the risks, because it is not possible to strictly define what is healthy. Example connected to housing: *Examples of key housing-related health risks include: respiratory and cardiovascular diseases from indoor air pollution; illness and deaths from temperature extremes; communicable diseases spread because of poor living conditions, and risks of home injuries*. [7]

[10] The eight principles of Calm Technology are: 1.Technology should require the smallest possible amount of attention, 2. Technology should inform and create calm, 3. Technology should make use of the periphery, 4. Technology should amplify the best of technology and the best of humanity, 5. Technology can communicate, but doesn`t need to speak, 6. Technology should work even when it fails, 6. The right amount of technology is the minimum needed to solve the problem, 8. Technology should respect social norms [6].

5. 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 IT-based solution. E.g., readjusting temperature or humidity in the room, turning of the lights etc. In short, there is a need to give a user control of his indoor environment in the same IT solutions that will provide feedback (app); eg. readjustment of thermostat setting will be done by the user agreeing to the introduction of temperature training.

6. Expert advisors

We suggest preparing **short video clips** (~ 30 sec to 1 min long) of experts providing advices or explaining relations (e.g. about temperature training and losing weight) which will be accessible via the IT solution. There should be a possibility for finding out more about a certain recommendation, for example by links to popular and scientific articles, connected to health, wellbeing, air quality, and energy savings. The videos should be **dubbed or subtitled in local languages**, since communication in English has been a serious barrier in interaction with users in most of cases.

7. Spreading the concept through leaders and trendsetters

When implementing the technology and approach for changing habits, we should focus on early adopters and trendsetters who are able to motivate others to use the novelty in a community. In practice, this could be achieved by **identification of existing formal and unformal groups of people and their leaders** (e.g. building communities, NGOs, sport clubs, student clubs, formal and informal communities and clubs of co-workers, informal communities of neighbours and people coming to the same restaurant or bar). If we manage to start collaborating with them already during the development phase and include their ideas and suggestions in the MOBISTYLE solution, it should be easier to motivate other users in different cases to accept it.

8. "Feel the energy" approach

The problem related to energy saving is that **energy is often impossible to be felt and cognitively processed**. For example, 1 kWh is not an intuitive and comprehensible quantity and it is difficult for most users to understand what should be done to produce and spend such an abstract amount. People are able to see the impacts of energy (temperature, light, operating devices…), however, they are unable to perceive the quantity of energy. A possibility to make energy more intuitive is connecting it to physical activity that can create energy – or at

least make an impression that we can make energy by our own movement.[11] In this way, we would be able to combine health, wellbeing, and energy production, and make the users *feel* how energy is made.

9. Public dedication to a goal

Anthropological, psychological and sociological studies [9] show that when an individual's decision for changing a certain habit is presented to other people and to public, this provides a strong "peer pressure" and stimulates a person to actually achieve a certain commitment. 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 **we can maintain stable social relationships with around 150 friends and acquaintances at most** [10], [11]. In buildings with less than 150 people, the inhabitants (or employees) have a feeling of a community, they meet each other and regularly communicate. According to our findings, buildings and settlements with larger number of inhabitants witness problems of breakdown of social bonds. In such cases, we should **support establishing new communities** and enable people to create new ties for helping each other and exchanging information through the MOBISTYLE solution.

4.2. Case-specific recommendations

Functionalities presented for each case are suggestion and not final solutions to be implemented. The inspiration for these recommendations came from our ethnographic studies and also from other sources, e.g. MOBISTLYE partners presentations.

Slovenia (public buildings)

- In public buildings, such as the University of Ljubljana with its several faculty buildings, the **existing or new displays** can be used as user interfaces. In addition, small screens or even more interactive tablets could be installed close to elevators which would advice people about healthy lifestyle and energy consumption.
- **Smartphone app** can be used to inform people about indoor (classroom) and outdoor temperature and air quality. The information can be supplemented by direct **recommendations for actions** (e.g. turning on lights, opening windows, doing some exercise)
- We can support group activities, e.g. engaging students to collaboration or competition between groups and departments. A simple example is using stairs instead of elevator.

[11] Charging stations for mobile phones at Amsterdam airport are an interesting example: the stations are powered by the energy produced by pedaling on stationery bicycles at WeWatt kiosks. Half an hour of cycling should be enough to charge most typical cell phones [8]

- **Voting about IEQ parameters** and their adjustment accordingly by **"health and energy democracy approach"**. For example, if a majority votes to decrease the temperature in the certain room, the building manager receives a notification to do so – he or she has also a possibility to overlook the initiative.

Poland and Denmark (residential buildings)

- Interaction with users can be supported by an **interactive screen (a tablet) attached on or near a refrigerator** which is a device present in all homes.
- Providing **constant feedback about energy costs** (primary) and carbon footprint (secondary) of individual apartment. Information can be supported by tips for changing habits and reducing costs and emissions of greenhouse gasses.
- **Indoor environment can be controlled either by smartphones or wearables** (personalized environment control based on info from wearable). For example, if all users leave their home (sensed by their devices), heating can be automatically switched off; when they are approaching home, it can be switched on. Similar principle can be applied to rooms; if user is in one room, it can be in comfort level, others can be in saving mode. A machine learning approach can be used for the solution to predict habits of the users and regulate devices at home accordingly (following the unobtrusive Calm Technology approach).

Poland

- **Costs** are an important motivator for changing habits.
- Tips about outdoor activities and natural ventilation can be based on **outdoor air pollution**.
- **Temperature training** is introduced and stimulated in the peak hours of heating demand thus reducing the costs of utility.
- Demand side management by stimulating "push" messages. For example, a user will be able to save money, if he or she washes clothes from 10 pm, i.e. during the lower electricity tariff. The solution could be used to inform the users about desired or most economical periods of use.

Denmark

- Providing **feedback about water consumption** and related costs.
- Sustainability (future generations responsibility) aspects related tips.
- **Intergenerational cooperation** in health and energy related activities (school and kindergarten can be the local "hubs" for promoting healthy and sustainable lifestyle).

Netherlands and Italy (short- and long-term guests)

- In the medical facility and the hotel, the users could get a wearable device at their arrival[12] and get **personalised information and recommendations based on individuals' measurements**. By this approach, the managers could get users preferences and will be able to do further profiling of guests (personalized invitations).
- By the use of movement tracking, we can create awareness and feedback on physical activity and combine it with health tips.

[12] Fitbits already used in the demo case for medical tracking purposes.

Italy

- Tips about possible activates in the surroundings eg. there is a concert in the city center today at 21, or the info about local weather forecast.
- HVAC control via app together with related health recommendations/ explanations about healthy indoor environment parameters ranges(temperatures, humidity, air quality…).
- Combining **technological and non-technological motivation tools** (flyers, billboards, remote controls …).
- Strategically **placing and designing the user interfaces**.

Netherlands

- **Transferring data and analytics from wearables to a smartphone app of personnel and patients**. The personnel should be able to use the data in order to improve sleep patterns, motivate the patients to do a certain type of activities, and to provide them quality food in right time. If doing so, privacy of patients should be strictly protected.
- Expert **advices can be selected and presented according to actual physical activities** based on wearables and smartphones monitoring data.

5. Conclusion

The main goal of this deliverable was to prepare recommendations for developing a new MOBISTYLE solution with potential to influence health and energy related habits. On the basis of an ethnographic study in five demonstration cases in different European countries we prepared the following **ten recommendations**: 1. using a smartphone as the main platform for communication between the user and MOBISTYLE solution, 2. enabling a possibility for the users to actively cooperate in creation and setting-up of their own profiles, 3. providing advices, adapted to users and their local environment, 4. implementing the Calm Technology principles, 5. enabling users to adjust various parameters influencing their indoor comfort through the IT-based solution, 6. supporting habits by expert advisors, 7. spreading the concept through leaders and trendsetters, 8. making energy more intuitive by primary associations connected to energy, 9. enabling public commitment to a goal, 10. taking into account a community size (up to 150 users).

The ethnographic inquiry and other people-centred approaches were relevant for the study and further development since they provided us some unexpected findings. For example, we assumed before we began the study that health ranks higher on priority list than energy, which has proven to be correct. However, it was surprising which *elements* of healthy lifestyle as a broad category are most relevant for people: food, sleeping, rehydration, etc. We have also realised that people didn't need and want new IT solutions for supporting and changing their habits, since they were already overwhelmed with technologies, devices, wearables and apps which try to influence their behaviour and "correct" their existing habits. Apparently, **technological saturation and cognitive overload with information** is a very important issue that has to be taken into account when designing new technologies in the MOBISTYLE project. The research also shows that **social pressure and support** could play an instrumental role in changing existing practices and supporting healthy and sustainable lifestyle. In addition, particularities of different demonstration cases and **case-specific recommendations** for each of them should be taken into account when adapting the general solution to different MOBISTYLE cases, since we a designing a solution for a variety of people of different age, gender, social and employment status who live and work in different settings, locations, buildings, and socio-cultural environments.

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