

# Using Participatory Heuristic Evaluation as a Collaborative Backbone in Large-Scale Projects – preliminary experience from the eWALL EU-Project

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## Abstract

Worldwide, the number of collaboration activities and large-scale projects (LSPs) increases. According to Harvard Business Review, LSPs contain several challenges related to strategy, interdependence, teaming, culture, norms, leadership, and different educational background. eWALL is an ongoing LSP with 14 partners where several evaluation methods are used, including Participatory Heuristic Evaluation. The applied method can be seen as a two-level approach: First, the eWALL system was evaluated using Participatory Heuristic Evaluation and, second, results of the Participatory Heuristic Evaluation were assessed by groups of project participants. Using the method and discussing the results in these meetings, not only focused on system improvements, but also facilitated fruitful discussions related to the overall goal, challenges, and progression in the project. Participatory Heuristic Evaluation proved useful for evaluating the system, and prompted the idea of using the formalism, i.e. as a collaborative backbone, at a higher managerial level to tackle some of the challenges associated with LSPs. In order to refine and prove the benefit of using Participatory Heuristic Evaluation as a collaborative backbone, further studies should be conducted.

## Keywords:

collaborative backbone, participatory heuristic evaluation, preliminary project experience, large-scale project

## Introduction

Worldwide, the number of collaboration activities and large-scale projects (LSPs) increases [1–5]. From 2007 to 2013 the European Commission allocated EUR 50.5 billion to the 7<sup>th</sup> Framework Programme for Research and Technological Development (FP7) [6]. FP7 is followed by the 8<sup>th</sup> Framework Programme for Research and Innovation running from 2014 to 2020, named Horizon 2020, which is estimated to exceed EUR 80 billion [7]. In addition to the EU funded projects, there are numerous other large-scale initiatives – both in research and industry.

Due to being highly complicated, planning and conducting, LSPs contains several challenges [2–4,8]. Some of the challenges are related to individual sub-agendas, costs overrun, schedule delays, and low performance [2,4].

The Harvard Business Review, owned by Harvard University, has over the years identified different reasons and explanations of why these challenges arise. They have documented that

strategy, interdependence, teaming, culture, norms, leadership, and different educational background are some of the core elements in this [1,4,5,9–12].

## eWALL, a large-scale project

An example of an ongoing LSP, which is financed by the FP7, is the large-scale European project eWALL for Active Long Living. The project has a duration of 36 months and a budget of EUR 8.8 million [13].

The aim of eWALL is to develop a device for monitoring health of older adults, provide easy access to doctors and sensing their daily activities with the goal to inform relatives if emergency occurs [13]. The users in eWALL are people with chronic obstructive pulmonary disease, mild dementia, and elderly with age related impairment.

eWALL is a joint venture where 14 partners from 14 different European countries have to manage all the challenges of running an LSP [11]. The work is divided into eight work packages; all being strongly connected and dependent on each other. The main technical and user requirements for the eWALL platform are unobtrusiveness in monitoring functions and seamless interaction with the primary and secondary end users (i.e., patients, and healthcare professionals and family, correspondingly). In the eWALL project, several evaluation methods are used, some of which are designed to provide an initial feedback on the user-friendliness of the adopted technology.

One of the evaluation methods is the so-called Participatory Heuristic Evaluation. Using this method has not only proven very useful for evaluating the system, but has also prompted the idea of using the formalism at a higher managerial level to tackle some of the challenges associated with LSPs. During the process, we found that using the method and discussing the results in meetings among project participants facilitated fruitful discussions related to the overall challenge and progression of the project.

The aim of the present paper is to report the results of performing a Participatory Heuristic Evaluation on the eWALL system and how this lead to the hypothesis that Participatory Heuristic Evaluations might be one of the collaborative backbones when running LSPs.

## Materials and Methods

The applied method can be seen as a two-level approach: First, the eWALL system is evaluated using Participatory Heuristic Evaluation and, second, results of the Participatory Heuristic

Evaluation are assessed by groups of project participants with respect to both implications for the system design and with respect to challenges and progression of the project. The two steps are repeated in loops during the project duration.

### The eWALL system

The eWALL interface application is a part of the final product, which is a prefabricated wall with incorporated functionalities and features for elderly citizens.

The functionalities and features of the eWALL system can be divided in the groups [13]:

- risk management and home safety
- eHealth
- lifestyle management

To illustrate these functionalities the initial layout of the menu structure in the interface software used by the citizens is shown in Figure 1. It should be noted that this is the first version of the interface and that major revisions and improvements will follow.

After logging into the eWALL system, the users are met by the main menu (Figure 2). The main menu contains two types of elements: 1) permanent widgets, and 2) start buttons for applications (Figure 3 and 4).

The permanent widgets show data of continuous and constant level of importance, produced and aggregated in service bricks. Widgets are reduced size display panels and do not require interaction. An example of one of the widget can be found in Figure 3.

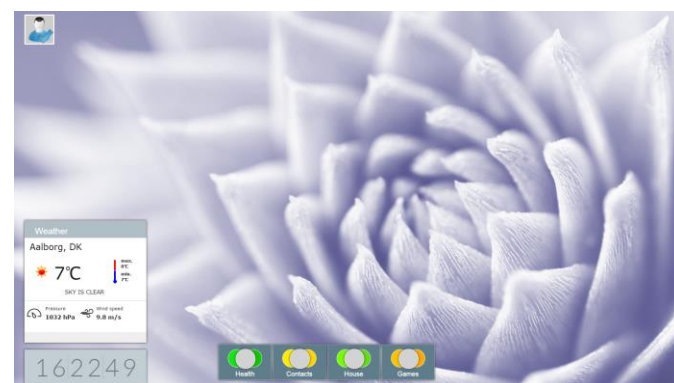


Figure 2- A screenshot of the experts and work-domain professionals in the Participatory Heuristic Evaluations

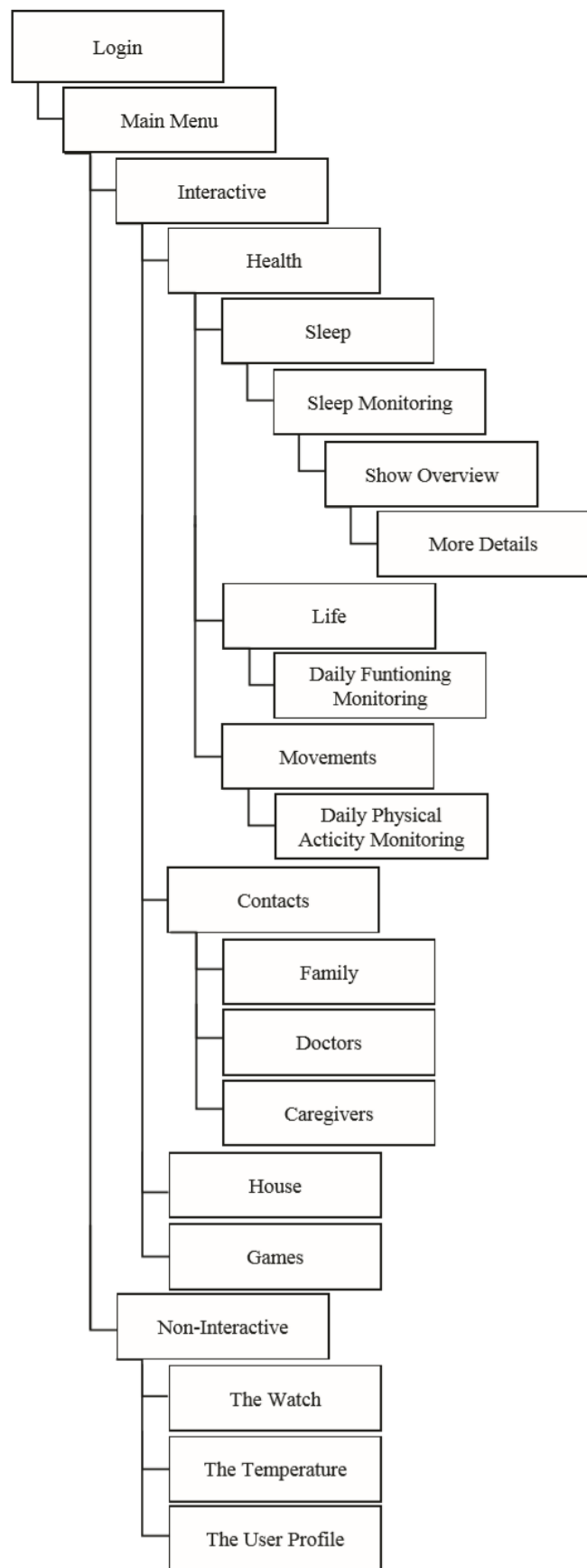


Figure 1- The architecture for the functionalities in the eWALL system

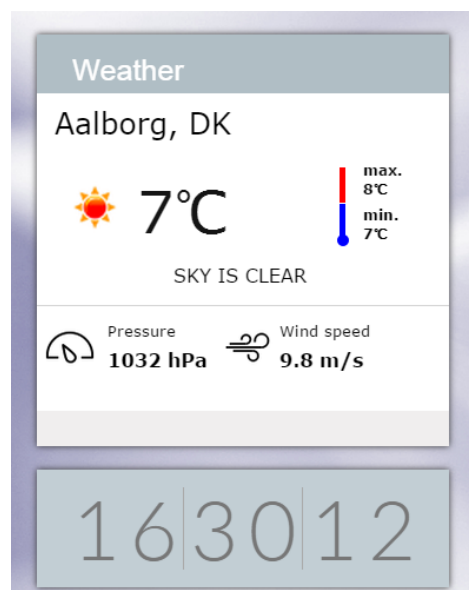


Figure 3- The weather-widget and the watch shown in the main menu of the eWALL system

The main menu contains four groups of applications – for example, for the group ‘Health’ there are three subgroups (see Figure 4).

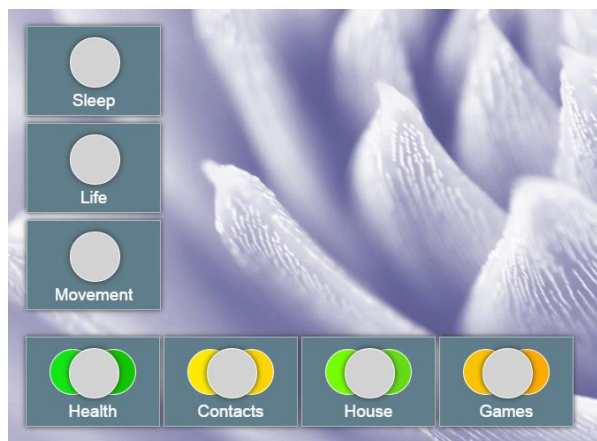


Figure 4- The four start buttons for applications available from the main menu. As shown on this figure, there are three subgroups of applications placed under ‘Health’

### Participatory Heuristic Evaluation

Participatory Heuristic Evaluation is a participatory inspection technique that serves as an extension to heuristic evaluation defined by the well-known usability expert, Jakob Nielsen [14,15]. In Participatory Heuristic Evaluation, experts in usability do an inspection as in traditional heuristic evaluation. The term traditional refers to the use of heuristics, a severity rating scale, and a log-schema [14]. After this, work-domain professionals are added as a group of users performing the same inspection. The purpose of extending the heuristic evaluation with these work-domain professionals is to complement the traditional inspectors’ more abstract knowledge with very specific knowledge from the work-domain professionals.

#### Usability experts

Five usability experts were recruited. Their educational background was Masters in Biomedical Engineering. Furthermore, three of the experts were ongoing PhD fellows and two of the experts were Associate Professors. The five usability experts were recruited from the Department of Health Science and Technology at Aalborg University.

#### Work-domain professionals

Two nurses were recruited to participate as work-domain professionals in the Participatory Heuristic Evaluations. Both of the nurses were Masters in Clinical Science and Technology and were ongoing PhD fellows. The two work-domain professionals were recruited from the Department of Health Science and Technology at Aalborg University. Both of the nurses had tried Participatory Heuristic Evaluations before. Despite the prior experience, they received a full introduction to the procedure.

#### Severity rating scale and 15 heuristics

The usability experts and the work-domain professionals were asked to categorize and comment on usability issues by means of Muller et al.’ 15 heuristics as shown below [15].

1. System Status
2. Task Sequencing
3. Emergency Exits

4. Flexibility and Efficiency of Use
5. Match Between System and the Real World
6. Consistency and Standards
7. Recognition rather than Recall
8. Aesthetic and Minimalist Design
9. Help and Documentation
10. Help Users Recognize, Diagnose, and Recover from Errors
11. Error Prevention
12. Skills
13. Pleasurable and Respectful Interaction with the User
14. Quality Work
15. Privacy

After identifying each usability problem the usability experts and the work-domain professionals were asked to grade the usability problem, by means of the following four severity rating scale [14]: 1) *cosmetic problem only*, 2) *minor usability problem*, 3) *major usability problem*, and 4) *usability catastrophe*. The goal of grading each usability problem was to get information about how severe the identified usability problems of the eWALL applications were.

#### Assessment of Participatory Heuristic Evaluation results in groups of project participants

After performing the Participatory Heuristic Evaluation, the results were assessed in a meeting among groups of project participants with respect to both implications for the system design and with respect to challenges and progression of the project. There was no detailed formal reporting of this activity – the outcome of the discussions can, explicitly, be seen in the minutes of the meetings and, implicitly, seen in how the participants handle the challenges related to a common goal, individual sub-agendas, costs overrun, schedule delays, and low performance.

### Results

The results are divided in direct qualitative results, quantitative results from using the Participatory Heuristic Evaluation, and indirect qualitative findings from the group discussions among project participants.

#### Qualitative results

The following results are linked to the main screen functionalities at the eWALL interface application (Figure 1).

- The font size is too small
- The font is unclear
- The colour contrast is too low
- If you do not speak English, it is difficult to choose language
- A keyboard is missing
- Required password is missing
- The watch is unclear to understand
- Information overload regarding the weather-widget

- There is no log-out button
- The symbols of the buttons are not easy to understand
- The main screen seems empty
- The grey buttons look moveable, but are not
- It is not possible to customize the weather-widget

### Quantitative results

From the Participatory Heuristic Evaluation, the usability experts and the work-domain professionals identified several usability problems by using the heuristics. Figure 5 illustrates the aggregated number of heuristics used by the usability experts and the work-domain professionals.

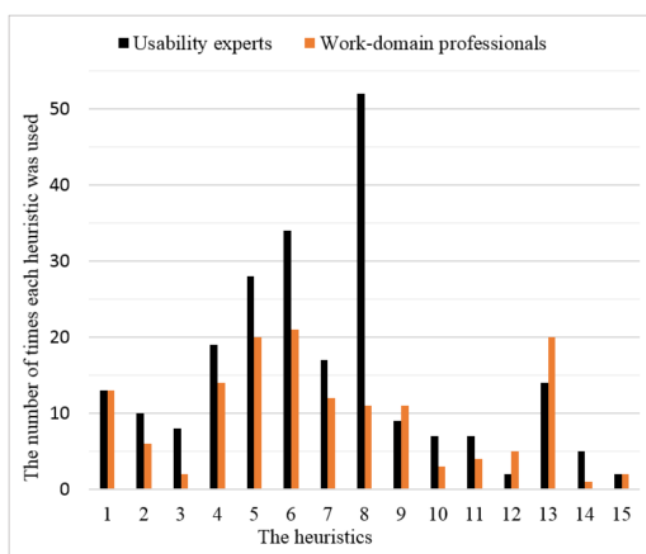


Figure 5 – The number of times each heuristic was used by the usability experts and work-domain professionals during the Participatory Heuristic Evaluations

Each usability issue identified by the usability experts and the work-domain professionals was rated using a four-scale severity rating. The result is presented in Table 2.

Table 2 – The table illustrates the number of times each severity grade was used by the usability experts and the work-domain professionals

Severity grade	How many times each severity grade was used			
	Usability experts		Work-domain professionals	
1	49	21,6 %	9	6,2 %
2	49	21,6 %	33	22,6 %
3	67	29,5 %	68	46,9 %
4	62	27,3 %	35	24,1 %
Total	227	100 %	145	100 %

### Outcome of the Participatory Heuristic Evaluation discussions among project participants

An example from the project work in two very different departments at Aalborg University will be used to illustrate the

process and the results of assessing the findings from the Participatory Heuristic Evaluation.

The project participants in the two departments did not know each other before the Participatory Heuristic Evaluation was organised and conducted. This means that none of the partners knew each other’s individual agendas, goals, norms etc. The involved partners came from the Department of Electronic Systems and the Department of Health Science and Technology. The former has a strong focus on technology as a discipline and the latter has a strong focus on health as a domain using technology as a tool to solve problems. They have very different educational background, different working methods and perspectives on technology.

The partners from the Department of Electronic System did not know the Participatory Heuristic Evaluation method beforehand. In the meetings afterwards, they described how they felt that the usability experts and the work-domain professionals had identified several unknown usability problems and they said that the method seemed to be very useful. The partners from the Department of Electronic System also said that they felt overwhelmed by the many usability problems that had been found – but they liked the way it was categorised and collected. Just reading the Participatory Heuristic Evaluation results, they felt that ‘their baby’ was under an attack, but during the discussions with the domain oriented partners they felt that they were able to have an objective approach to the eWALL system, because they could see the relevance and importance of the identified problems.

The partners from the Department of Health Science and Technology to begin with felt that the domain always is more important than the technology but that this view was not shared with the other department. They felt that the partners in the other department had the idea that domain experts knew far too little about technology to have a say on the design and testing of technology.

During the discussions both partners realised that the usability experts and work-domain professionals could be regarded as neutral third parties – that the results from the Participatory Heuristic Evaluation should not be regarded as ‘the truth’ but more as a starting point for a fruitful discussion on both the system and the goal of eWALL. From discussions of the higher-level aspects of eWALL, both partners realised that several aspects of the challenges of running a LSP were included. Both partners felt that, much better than formal presentations of other partners’ competencies and contributions, the Participatory Heuristic Evaluation had served as an informal means of collaboration.

The partners from both departments agreed to the need of more rounds of system development, Participatory Heuristic Evaluation, and assessment in groups of the results from the Participatory Heuristic Evaluation – successive loops – in order not only to evaluate and improve the system, but also to overcome the challenges related to strategy, interdependence, teaming, culture, norms, leadership, and different educational background in a large scale project.

### Discussion

From the qualitative Participatory Heuristic Evaluation results, we saw that the usability experts and the work-domain professionals had identified several severe issues regarding the main functionalities of the eWALL interface application. The qualitative problems were very different in nature ranging from missing elements on the screen to lack of customisation to the

end users and to general usability problems due to not following the heuristics.

From the quantitative Participatory Heuristic Evaluation results we saw that the heuristic no. 8, *Aesthetic and Minimalist Design*, was the most frequently used heuristic among the usability experts. The second and the third most frequently used heuristic were no. 6, *Match Between the System and The Real World*, and no. 5, *Consistency and Standard*. In comparison, the most used heuristic among the work-domain professionals was no. 6, *Consistency and Standards*. The second and the third most used heuristic among the work-domain professionals were heuristic no. 5, *Match Between the System and The Real World*, and no. 13, *Pleasurable and Respectful Interaction with the User*.

It should be noted that the four heuristics, which the usability experts and the work-domain professionals used the most, are closely related. Basically, they all focus on pleasurable and respectful interaction between the user and the system. If the design and the aesthetic of the system is unclear and unattractive, and the layout of the system does not follow usual standards, then, according to the usability experts such as Jakob Nielsen, it is very likely that the users will experience troubles with the system and thereby skip the system [16].

For the heuristic no. 8, *Aesthetic and Minimalist Design*, we see the largest difference between the two groups of experts. There is no obvious explanation to this difference and other studies have not found the same significant difference [17]. The result that heuristic no. 8 is the most frequently used heuristic, is in line with Nielsen who talks about the ‘importance of first impression’ and the number of seconds users stay on a page before they leave it [16,18].

The fact that usability experts and work-domain professionals have a very different professional background and, therefore, are likely to have different priorities is reflected by the differences in their findings thereby illustrating the point of using both types of professionals.

In Table 2, it is illustrated how the usability experts have a quite uniform distribution between the four severity grades and how the work-domain professionals grade very few problems as cosmetic and almost half of the problems as major, indicating that work-domain professionals may have a tendency to express their opinion on these issues more strongly.

Overall, it is not surprising that the usability experts and the work-domain professionals identified very severe, and numerous, problems during the Participatory Heuristic Evaluation. According to usability expert Jakob Nielsen, this is almost always the case. He, therefore, recommends an iterative approach allowing larger problems, which may take the focus away from smaller problems, to be solved first, after which the system is updated before being tested again [19].

From Participatory Heuristic Evaluation discussions among project participants, we saw that the individuals from different partners slowly began to change their view on what they could get out of the interaction. They changed their view from the perception that the purpose was to agree, on which findings were the most important and how the issues could be solved, to realising that they as a side-effect got more insight into other aspects of the project and a wider understanding of a common goal. The partners began to collaborate as a team with the same goal rather than act as competitors.

Inspired by our findings and experience in eWALL, and by the findings of Harvard Business Review [1,4,5,9–12], we have derived at the hypothesis that Participatory Heuristic Evaluations might be one of the collaborative backbones when run-

ning LSPs, not only in eWALL but also in other projects. In eWALL, we have taken the first step in the looping process: i.e. rounds of system development, Participatory Heuristic Evaluation, assessment in groups of the results from the Participatory Heuristic Evaluation. Whether such successive loops can be a backbone for not only evaluation and improvement of the system, but also can be a way to overcome the challenges related to strategy, interdependence, teaming, culture, norms, leadership, and different educational background in a large scale project, is to be seen when, in due time, we evaluate eWALL. If we succeed in eWALL, further studies might be conducted in order to refine and prove the benefit of using Participatory Heuristic Evaluation as a collaborative backbone.

## Conclusion

Participatory Heuristic Evaluation was proved very useful for evaluating the eWALL system and, in addition, prompted the idea of using the formalism, as a collaborative backbone, at a higher managerial level to tackle some of the challenges associated with LSPs. Further studies should be conducted to demonstrate the benefit of the approach.

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