

# Exploring the Effectiveness of Building Performance Codes: A Lighting Standard Case Study



Elisabeta Manescu, Ulrich Pont, Ardeshir Mahdavi  
Department of Building Physics and Building Ecology, TU Wien, Vienna, Austria

## Introduction

This Poster is based on the research paper *Exploring the Effectiveness of Building Performance Codes: A Lighting Standard Case Study* and a Master Thesis conducted in this field [1].

Building performance criteria support the quality assessment of buildings in different domains. In general, building performance assessment requires a common and comprehensive definition of indicators, planning guidelines, and related information. Hereby, standardization is an important tool. In recent years, both the number of standards in the building domain as well as the extent of these standards increased. A thorough, clear, and comprehensive definition of performance criteria, description of evaluation methods and calculation schemes can support knowledge-based building design. However, the question must be asked, if such standards offer a high level of usability for their audience (professionals, official bodies, broad public). Toward this end, we focused in this contribution on the domain of building lighting standards and their usability.

Definitions of Usability can be found in standards, and are, for instance, defined as illustrated in Figure 1.

Usability is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". (EN 9241-11, CEN 1998)

Usability is "a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users". (ISO 0126-1, ISO 2000)

Main features:

- Understandability
- Learnability
- Operability
- Attractiveness



Figure 1: Standardized definitions of Usability

## Methodology

### Overview:

- Usability assessment / Lighting standard
- Professional's evaluation via questionnaires
- Experiment with graduate students

### The standard used in this study:

- EN 12464-1 Light and Lighting – Lighting of Workplaces – Part 1: Indoor Work Places

### Questionnaires:

- Qualitative interviews with 5 domain specialists
- Questionnaires to lighting professionals in Austria and UK
- Addressing different aspects (Figure 2):
  - Identification of planning steps that require the use of standards
  - The role of standards in the planning process (facilitate vs. aggravate of processes)
  - Standard requirements role regarding improving the quality of lighting design
  - Understandability of standards
  - Optimization potential for standards

Usability Criteria	Evaluation Question
Effectiveness	How would you evaluate the Standard? (General effectiveness)
	Does the standard state the design requirements in a clear and unambiguous manner?
	Do the minimum requirements of lighting levels in the current Standard limit the flexibility in designing energy efficient solutions?
	Does the current version of the Standard consider new technologies (e.g. LED)?
Efficiency	Do requirements in the Standard address real-life issues that can affect lighting? (E.g. surfaces, colours, dust, smoke, etc.)
	Do you think that recent research results about lighting and human/vision/health are sufficiently included in the current standard?
Satisfaction	How easy is it to find information in the Standard?
	How accessible is the language of the Standard?
	Is it easy to verify that all requirements in the Standard have been met after the project is completed?

Figure 2: Evaluation questions for domain specialists

### Experiment setup:

- Students of Building Science and Technology → limited background knowledge
- Students were asked to familiarize themselves with standards
- Students were asked to perform certain tasks (finding information and definition, describe the topic and content of sections, etc. see Figure 3)
- Students were asked to evaluate the standard's usability regarding effectiveness, efficiency, and satisfaction based on certain questions (see Figure 3)

Usability Criteria	Subcriteria	Task / Question
Satisfaction	Task 1a - Familiarization with the Standard (15 minutes total)	Do you know how to find information in the Standard? Where you able to identify the main chapters and what they contain? Would it be easy for you to find specific information in the Standard?
	Task 2a - Finding and understanding information (15 minutes)	Define "Task area", "Immediate surrounding area" and "Background area" and provide lighting requirements for each from the Standard. Where you able to find the information in the Standard?
	Task 2b - Finding and understanding information (10 minutes)	Did you find the information where you expected to find it? Number of steps to find the information. Is the information clear to you now?
Efficiency	Task 3 - Practical "real-life" example (20 minutes total)	Write down all relevant requirements for an office space as stated in the Standard. Where you able to find the information in the Standard?
		Did you find the information where you expected to find it? Number of steps to find the information.

Figure 3: Tasks & questions used in the graduate student's experiment

## Results and Discussion

### Questionnaire's results:

- Figure 4 illustrates the results of the questionnaire (response rate 20% => 28 participants): Figure 4a: Questions pertaining to effectiveness; Figure 4b: Questions pertaining to efficiency; Figures 4c: Questions pertaining to satisfaction

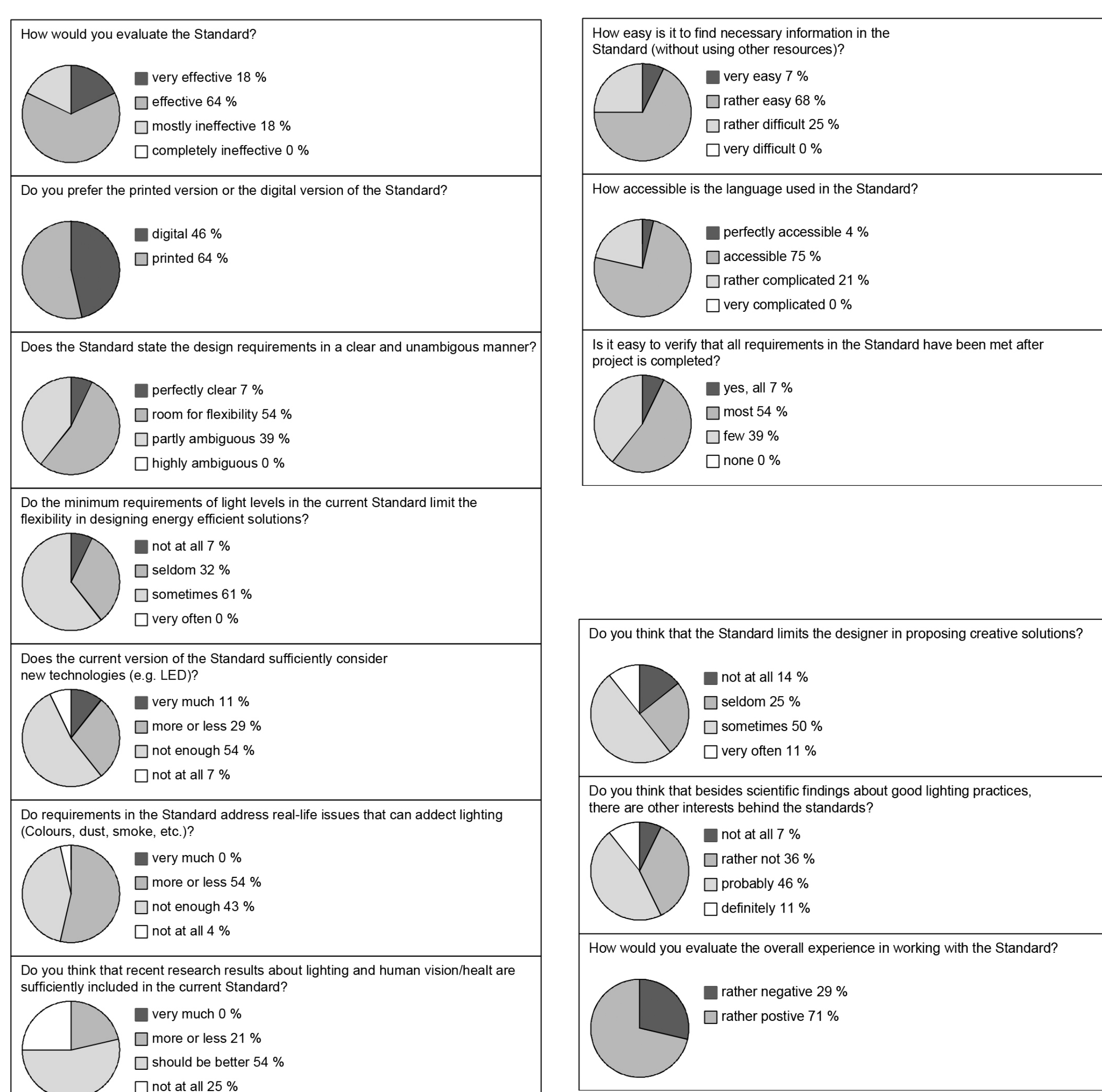


Figure 4: Questionnaire's result regarding effectiveness (4a, left), efficiency (4b, top right), and satisfaction (4c, bottom right)

### Experiment's results:

- Figure 5 illustrates tasks and results of the experiments with the graduate students, as well as their feedback after performing the tasks. 37 graduate students participated (age: 21 – 32).



Figure 5: Experiment tasks and results from left to right: Task1, Task2a, Task2b, Task3, Participant's feedback

## Conclusion

The results of this study revealed that some interesting insights: (i) Professionals tend to judge the standards positively in regard to usability, however the majority of them reckons issues regarding the real-life appropriateness of standards. Furthermore, the ambiguity of some requirements and formulation was criticized. (ii) Users of the standards with limited background (graduate students) sometimes struggle to get them familiarized with the standard under time-pressure. Moreover, it can happen that unexperienced users tend to forget to crucial requirements stated in the standard, whereas they are at the same convinced they fulfilled all requirements. In [1] a full results discussion and conclusion can be found.

## Kontakt

Ulrich Pont  
Department of Building Physics and Building Ecology, TU Wien  
Ulrich.pont@tuwien.ac.at

## Referenzen

[1] E. Manescu. *Usability of Building Performance Standards in View of Design Support – Lighting Standards*. Master Thesis. TU Wien, 2015

