

Giving UI Developers the Power of UI Design Patterns

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Abstract. UI developers interested in UI design patterns generally face major problems when trying to use them, because of the complexity of pattern libraries and the lack of supporting tools. As a consequence, UI design patterns are not widely used and this entails an important loss of productivity and quality. In this study, we identified and wrote 30 UI patterns that were made available in a library, and we compared four modes of presentation for them: pattern thumbnails, application types, decision trees, and alphabetical mode. Ten subjects participated in the study. User satisfaction was higher with the three new modes than with the alphabetical mode. Search time was higher with the three new modes than with the alphabetical mode. Although difficult to evaluate, pattern relevance was better with the three new modes. Those findings were turned into recommendations for immediate applications. In the conclusion, we propose some research avenues for the future.

Keywords: user interface design patterns, design pattern libraries, pattern language user interface design, mode of presentation.

1 Introduction

« Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice. » [1]

Design patterns capture invariants of a proven *solution* to a recurring *problem* in a specific *context*. They are reusable knowledge blocks, written in plain text following a predefined format, and possibly illustrated by photos, code samples, diagrams, etc. Patterns are often organized in a *language* that is related semantically and hierarchically, in order to generate complete design solutions [1].

Christopher Alexander set a landmark in architecture when he wrote the first patterns, 30 years ago. His idea has since spread into the fields of pedagogy, business processes, object-oriented programming and Human Computer Interaction (HCI).

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The use of user interface (UI) patterns remains low, in spite of the large quantity of available pattern languages [2]. Indeed, interface developers do not use UI patterns much for various reasons:

- *A lack of organization*: as a pattern language grows, it can accommodate more than a hundred patterns. Without clear entry points, shortcuts, or guidance, finding the right pattern often amounts to skimming through the entire list. This heavy work load adds to the regular tasks of developers.
- The convolution of *current patterns*, written by « usability engineers or experienced UI developers » [3] for themselves [4]. Interface developers are not familiar with the concepts, methods and vocabulary used in human factors engineering; thus it is difficult for them to estimate the relevance or applicability of a pattern to a situation [3]. They also have difficulties understanding how patterns are related and how to benefit from these relations.
- *A lack of tools* for supporting interface developers [5] and reducing their workload.

The difficulty of using UI patterns may entail a huge loss of productivity and quality for interface developers who actually code the UI, as they pass over a tool that can « improve the consistency of the user interface and UI quality, make designing and implementing more efficient, provide business advantages for software companies, and work as a common language communicating the design knowledge to the designers, developers, and other stakeholders » [6].

2 Our Approach to Write and Present UI Patterns

Our research work on UI patterns is based on four main activities: an extensive literature review which allowed us to draw lessons from others' work on UI patterns, an analysis of different training and simulation tools interfaces developed at CAE, discussions with human factors specialists who knew the needs of UI developers at CAE and were looking for more rigor and consistency in UI, and discussions with several UI developers at CAE since they are the end users of the UI patterns.

We wrote 30 UI design patterns for training and simulation support tools developed at CAE, and shared them on the company network on a need-to-know basis. They have been actively used and validated by more than 50 engineers, human factors specialists, and UI practitioners, and tweaked in the light of the feedback of these professionals.

We wrote UI patterns following the usual « Problem-Context-Solution » format, with a heavy use of bullet points (rather than dense paragraphs) and example imagery (up to half the content of the pattern). This aimed at increasing legibility, understandability and appeal of the patterns for developers.

Furthermore, UI patterns were structured according to three modes of presentation we developed: *application types*, *decision trees* and *pattern thumbnails*.

Application types are halfway between *postures* as defined by Welie [7] and *Standard Screen Patterns* as defined by Neil [8]. They are textual and visual representations of stereotypes or software genres like Web browser, spreadsheet, media player, to which a predefined pattern collection is linked. As the quantity of application types

The goal of our study is to compare the performance of four modes of presentation of UI patterns: the three modes described above and a reference mode, which is a one-page alphabetical index linked to all patterns in the database, much like in Welie's, Tidwell's or Malone and Crumlish's libraries¹.

3 Methodology

Subjects. Ten professionals from CAE participated in the study. Four are software developers, four have team or project management responsibilities, and two have graphical or quality assurance tasks. None of them had heard of UI design patterns or seen CAE's patterns library before. The age varies between 25 and 53 years old.

Task. Subjects were asked to find, with each of the four modes of presentation, a pattern suitable to a specific CAE user interface they had freely chosen at the beginning of the test. « Suitable » could either mean: « That would significantly improve the chosen UI » or « That is already and correctly applied in the chosen UI ». The subjects were not asked to technically apply the pattern, since this study only focuses on evaluating the capability of each mode to help one find rapidly a relevant design pattern. The library contained 30 UI patterns; each time the subject found a pattern with a mode, the same pattern could not be used with another mode and the different modes were used in a random order by the subjects.

Data. Data collected about each mode were about these parameters: the time required to find a suitable pattern, the user satisfaction about the mode, and the relevance of the selected pattern for the initially chosen CAE user interface. The data about the last two parameters were collected through an interview at the end of the session. We evaluated the subjects' first-contact experience with the library: if they could find a relevant pattern on their own and were interested in using it. The subjects were asked to comment aloud their activities while examining the pattern library and choosing a pattern.

Procedure. At the beginning of a test session, we welcomed the subject, explained the goal of the study, had the subject complete a short biographic questionnaire, and gave brief instructions about the task to perform and the sequence of events during the session. The test was held at the subject's desk, in the presence of the experimenter (the first author of this paper) who observed the work done by the subject, collected the questionnaire, and asked questions.

4 Results

Subjects were very successful for finding UI patterns. They found patterns 37 times out of 40 trials: the three failures are due to work-induced interruptions of the trial.

¹ www.welie.com/patterns/
<http://designinginterfaces.com/>
www.designinsocialinterfaces.com/patterns/

User satisfaction is higher with the three new modes of presentation than with the alphabetical index (see table 1 and table 2): with the application types and the decision trees it is 42% higher (3,7 vs 2,6), and with the thumbnails it is 73% higher (4,5 vs 2,6). Moreover, the standard deviations is lower for the ratings of the new modes, especially the thumbnails, than the rating of the alphabetical order.

On the other hand, the search time of the UI pattern is higher with the new modes (see table 3): 11% higher with thumbnails (03:26 vs 03:06), 23% higher with decision trees (03:48 vs 03:06), and 51% higher with application types (04:41 vs 03:06). We will see below that this may comprise some advantages. Standard deviations are similar this time, nearly one minute for every mode.

Thumbnails have the highest user ratings for satisfaction and are the favorite mode of 7 subjects out of 10 while being the second best mode for searching time. Conversely, alphabetical index is the most rapid mode but with the worst rating of user satisfaction.

Design patterns found with application types and decision trees modes were generally more relevant to the benchmark UI than patterns found with thumbnails and alphabetical index. It is worth reminding that all the modes were referring to the same pattern library. The relevance of a pattern for a given UI is somewhat subjective and

Table 1. Modes of presentation preferred by the subjects (each participant had to pick one out of four)

Alphabetical index	Application types	Decision trees	Pattern thumbnails
0	3	0	7

Table 2. User satisfaction for four methods (Likert scale from 1 to 5, the higher the better)

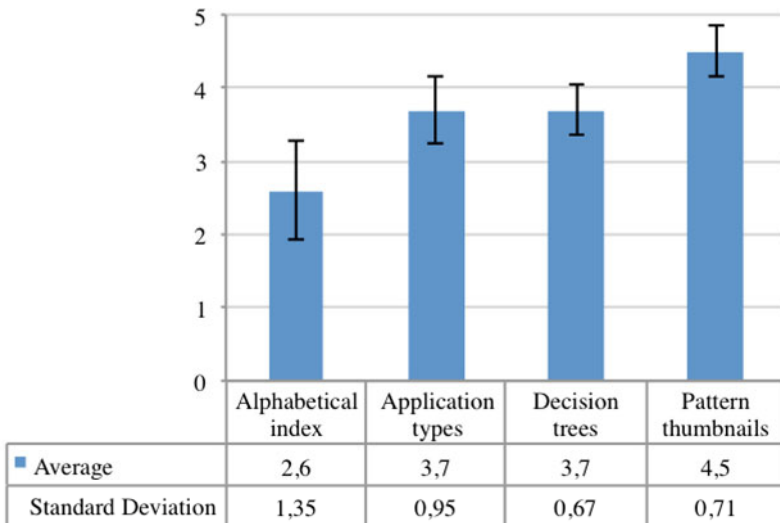
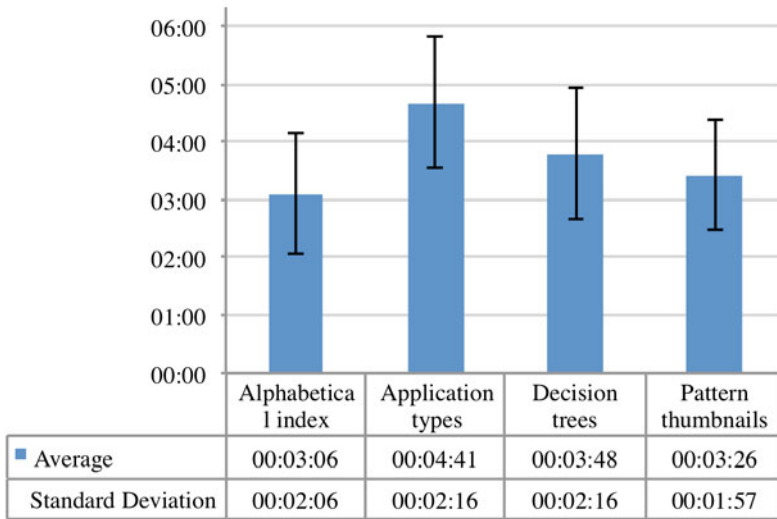


Table 3. Time required to find a pattern (the lower the better)

hard to agree upon, yet the findings show a clear trend: patterns found with thumbnails and alphabetical index methods were generic, including all-purposes recommendations such as Good typography or Good color. Whereas patterns found with application types and decision trees modes, like Cloak of shadows or Mega drop-down, were more specific and with a greater value for design.

In addition, most of the subjects have praised at length the choice, quality, and quantity of examples in the patterns as well as the bullet writing style even though these particular aspects had not been mentioned by the observer.

5 Discussion and Recommendations

5.1 Discussion

The overall response to the proposed approach, new modes of presentation and writing style, has been very positive.

CAE UI patterns library was deemed attractive, and the subjects, with no previous knowledge of UI design patterns, were able to find patterns relevant to their situation with a high satisfaction rate. The search time was higher with the new modes but this result actually seems to be a good thing: excess time wasn't spent on hit-or-miss, on trial-and-error blind exploration of patterns as with the alphabetical index, but rather on reading additional details or thinking about the problem. Context and guidance provided by the new modes of presentation may require more time, but this could be readily accepted by the subjects as it leads to more relevant patterns and a better understanding of UI issues.

Furthermore, application types and decision trees act as multiple and targeted access points to subsets of the library, *de facto* chunking it for UI developers. This chunking,

along with the context provided through textual and visual documentation, contribute to building the subjects' mental model of the UI principles. It also decreases the workload of using the library: developers do not have to know anymore the library by heart to select the right pattern. Recognizing the problem they are confronted to or the type of application they are working on is enough to provide a solution.

The complementarity of the modes was also noted. Application types received better ratings from subjects involved in new products, where the UI had yet to be designed, because they gave them a starting point. On the contrary, the decision trees received better ratings from subjects involved in mature products with specific UI problems.

The pattern thumbnails were really appreciated and are useful on two levels: first as an introduction to the library, playing on the user's curiosity (subjects enjoyed guessing the meaning from the thumbnail and spent time doing so even when they already had found a suitable pattern); second, as a nice quick reference for advanced users, providing rich information at a glance.

Yet focusing solely on thumbnails would be a mistake. Application types and decision trees, although less ostentatious, provide more accurate answers and much more context, which is beneficial in the long-term to the UI knowledge of software developers.

Most subjects expressed their liking of several modes at the same time and urged us on not picking one at the expense of the others.

5.2 Recommendations

- Supporting each pattern presentation with a pattern thumbnail.

It is a low-cost yet effective way of achieving findability and it conveys a lot of meaning. The visuals used should be schematized in order not to silently enforce a particular visual style nor a specific technical solution.

- Support the library with application types and decision trees.

They are the modes yielding the best results, but since they are harder to define and write, it is better to first have a steadfast library and a fine understanding of the organization to build upon.

- Keep an alphabetical index available.

Even if they do not use it, subjects feel safe having a « no surprise » solution available. Some users use it to gauge the scope of the library at a glance.

- Write patterns using bullet points and several carefully chosen examples.

They make patterns easier to grasp for an audience that has no training in HCI.

- Keep resources for « the usability of usability ».

The new browsing modes mean added writing, coding and drawing. This may constrain a team with limited resources to write fewer patterns *per se* in order to make the remainder accessible to interface developers.

6 Conclusion

Our results are encouraging, even though not all positive, since the subjects who participated to the study were able to find UI patterns on their own, their satisfaction with

three new modes of presentation of patterns that we devised was higher than with the conventional alphabetical mode, and the relevance of patterns they found with these new modes was better than with the alphabetical mode. Hence *application types*, *decision trees*, *pattern thumbnails*, and a very visual writing style can be considered as effective and reliable to make patterns easily accessible to UI developers with no prior HCI training. The four modes of presentation we tested are not exhaustive and it is worth making the effort to devise and test new ones for the benefits of UI developers, and of other stakeholders of the enterprise (e.g., clients, partners).

Finally, the « language » aspect of design patterns has been deliberately left out of this paper, mainly because the accepted definition of pattern language varies widely. As of now, our patterns are indeed naturally structured around application types and decision trees that perform like thematic « hubs ». However, this way of working only accounts for a small part of the functions of a pattern language; here lies a huge area of improvement.

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