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Usability Patterns for Geoportals

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Abstract

Current geoportals and metadata catalogues, as user interfaces for discovery and exploration for geodata do still suffer from lacking usability, regardless whether experts or non-expert users are considered. Design patterns are well established in software development to tackle frequently occurring problems. Usability patterns are a specialization of such design patterns to specifically address user interface issues and related software solutions. However, existing usability patterns are not sufficient to cope with GI-usability issues as for instance related to discovery of geodata. This poster submission introduces an adapted GI-usability pattern concept.

Keywords: Usability, Pattern, Discovery, Geoportal

1 Motivation

Design patterns describe general reusable solutions to solve frequently occurring problems [1]. In software engineering, this concept has been established and proven for years and extended for several aspects.
Current geoportal implementations still show various and frequent usage issues, e.g. during search and visualization processes. Typical usability problems are linked to the representation of search results (e.g. unclear labelling, irregular result categorization), to the navigation in the result sets (e.g. missing links between dataset and service metadata description, only one-way navigations) and to filter, sorting and selection functions (e.g. missing scope restriction functions, inconvenient arranged elements). These usability problems recur in various geoportals and significantly decrease the acceptance of geoportals. Therefore GI-usability patterns are suggested as a promising concept, to first summarize and categorize typical geoinformation (GI) usability problems, and second to define common solution approaches, partly being adapted from best practices in other application domains.

2 Usability Patterns and their Relations to GI-Applications

Design patterns are a well-accepted concept in software engineering [6]. As user interface (UI) design has becoming key for the acceptance of software solutions, several usability patterns, as a specific sub-set of design patterns have been suggested. These patterns should be used to improve the usability of a software product and

Table 1: Usability pattern “Direct Validation” [2].

Usability pattern	**Direct validation**
Description	When users enter data in a form that requires a specific format or has constraints on the inputs they want to identify and correct invalid entries immediately.
Solution	Validate input values during input automatically. … Show directly whether inputs are valid or invalid. Use an easy to understand, but restrained manner of presentation. Users should not be distracted and their input should not be interrupted. In case of invalid values, show the user a hint to explain the validation criteria and to correct the mistake.
Example	Creating a Google account The user must enter his current email address when creating the Google account. If the user changes to the next input field after entering the e-mail address, the system automatically validates the entered address. In case of invalid input values the system shows a specific hint (e.g. “do not forget the @-symbol”)
Context	Situations in which inexperienced users need guidance for entering data Dialogs that require several input values that should be validated Free-text entries in formats that are unfamiliar or complex for users …
Rationale	Direct validation helps the users in a simple and understandable way to enter valid data. Users identify erroneous entries immediately and can correct them quickly. With specific advice on what input is expected, the system will be more conducive to learning. Time lags between data input, feedback and correction are minimized, because of immediate system responses. This avoids a change of context: Users recognize potential mistakes immediately and not after several further steps.
Conse-quences / costs	Validation requires time. Therefore validation of input values can lead to noticeable undesirable delays, which could harm users’ satisfaction. In this case, a validation steps could be aggregated executed at the end of a user interaction…
Related patterns	Complement: indulgent format Complement: Auto complete

to illustrate functional solutions for usability problems in specific usage contexts, being either related to specific UI elements or to UI interaction concepts or to both [2].

Usability patterns are described by a set of design pattern attributes (name, problem description, solution) as given in table 1. However, as they stand these attributes do not provide any assistance on how to best place UI elements, or on how to best realize relations between UI elements, or towards creating consistent user interaction concepts.

Current usability patterns do clearly also describe usability aspects, which are relevant for implementing geoportals (e.g. auto complete, indulgent format or time and place-aware filters). However, they lack a specific focus on GI-applications, such as dealing with geodata types, relations between metadata and geodata or web map functions.

Consequently a GI-extended usability pattern concept is proposed, which builds on existing well-recognized patterns but also addresses geoinformation aspects. As a first subset of such GI-usability patterns, this submission focusses on geoportal implementations.

3 Usability Patterns for Geoportals

Taking geoinformation discovery as the overarching concept of a typical geoportal implementation the developed GI-usability patterns have been organized along a hypothetical discovery workflow. Thus, the patterns address the various sub-steps in such a workflow: formulating a search query, filtering results, visualising result sets on a map, etc. One important function in geoinformation discovery is map visualization. Nevertheless, in some applications it is either not implemented or easily navigating and interchanging search and map display is complicated or impossible. Here, table 2 provides an example of the general description of the GI-usability pattern *Provide map link from dataset*. This pattern tackles the issue of

Table 2: GI-usability pattern example "Provide map link from dataset view".
One pattern can be related to several attribute values (e.g. Search phases: 2 Discover of results, 3 Evaluate a result; most relevant value is underlined). Context attribute values and pattern relation types cannot be defined freely (fixed values written in italic). Attributes that do not suit a certain pattern context do not need to be set (marked with *).

GI-Usability pattern	**Provide map link from dataset view**		
Description	Users often evaluate the fitness for use of data by examine their metadata and visualization. An interactive map helps to navigate through the data. Generally, the navigation to the map is complicated (via service metadata) and needs GDI knowledge. Further, users do not know the difference between dataset and service (novice users) or need a short navigation path to the map (expert users).		
Solution	The application should provide a direct link from metadata (service as well as dataset) descriptions to the related map visualization.		
Rationale	A map serves as expressive instrument to visualize geodata. It helps users to analyse geodata visually and to evaluate the fitness for use. An interactive map can further be used to analyse the visualized data on several levels of details and to focus different regions. The map with the desired data should be easily accessible for the user. Therefore direct links to the map client are very important.		
Consequences	Map visualization should only be provided, if the geodata can be visualized on a map (e.g. standardized format). Direct links from dataset detail descriptions to the map can be realized as parameterized calls. Providing this function is more expensive than providing direct links from service descriptions, because the relation information is stored in service metadata and not in dataset metadata.		
Related patterns	Provide link from dataset view *is specialization of* Provide link to map visualization Provide link from dataset view *is similar interaction as* Provide link from service view		
Context	Activity context	Search phase	*Discover results* *Evaluate a result*
		Search dimension	*Content: Spatial extent, Temporal extent, Thematic categorization* *Result: ** *Relation: Dataset-Service* *Task: View map visualization*
		Search strategies	*Explorative search*
	UI context	UI elements	*Type: Control* *Relation: Above, Under, Next to Detail descriptions*
	User context	User types	*Novice users, Expert users*

most geoportals to (1) force users to first find a dataset and a related service description before they can view the geodata visualization and to (2) not support an easy tow-way navigation from dataset descriptions to the related map visualizations (and back), thus hampering users in executing a first visual data inspection (Table 2, Description, Rationale). As links to visualizations are only provided in web service descriptions, but are hardly given in any geodataset description, the implementation is more cost-intensive than providing map links from service descriptions (Consequences).

The pattern requires, that the map visualization (Search dimension: task) should be provided for the evaluation of a search result (Search phase) and the direct linking allows novice users to navigate to the map more easily and experts to explore the data more quickly (Description, Search strategy, User types). Regarding the UI and interaction concept, the map link has to be implemented as a UI control element, e.g. link or button, which should be placed near the dataset descriptions (UI elements) and provide the same interaction as the map link from service descriptions (related patterns).

The usability patterns for geoportals, such as *Provide map link form dataset view*, have been structured and attributed in such a way, that software designers get best supported in finding an appropriate pattern for their geoportal implementations. Table 3 provides an overview on the attributes being used to categorize the GI-usability patterns and shows the attribute domains. Thus, the attribute *search phase* allows developers to filter patterns that suit for a certain search related software part such as the provision of a result list or to generate phase-specific checklists for usability tests. Offering such search dimensions are a proven concept to classify search results and to distinguish results that match the same search term [4]. They allow developers multi-dimensional filtering and offer several entry points to discover the GI-usability pattern matrix.

GI-usability can also be organised in relation to the problems they address or according to the relations between the patterns. Figure 1 shows five map visualization patterns and their relations being classified into four types: Patterns can complement each other, e.g. “Visualize on a map” and “Provide link to map visualization”, they can be dependent on each other, e.g. “Provide link to map visualization” and “Provide link back to previous page” or be related in a hierarchical structure, in which one pattern serves as specialization of another pattern. Existing usability pattern concepts do not ensure an overall consistent interaction design of an application. Therefore a pattern relation type “*is*

Table 3: Structure of Context Attribute for GI-usability patterns (attributes and sub-attributes written in bold, allowed attribute values written in italic).

Activity context	**Search phase**	*1 Formulate search query* *2 Discover results* *3 Evaluate a result* *3.1 Visualize result data* *4.1 Formulate new search query* *4.2 Filter or refine results* *5 Use results*
	Search dimension	**Content***: Spatial extent, Temporal extent, Thematic categorization Context (e.g. Organization)* **Result***: Dataset, Service, Documentation, Metadata* **Relation***: Dataset-Dataset, Dataset-Service, Dataset-Documentation, Dataset-Producer* **Task***: View map visualization*
	Search strategies	*Explorative search* *Known item search*
UI context	**UI elements**	**Type***: Input, Control, Information, Personalization* **Relation***: Above, Under, Next to, Replace by*
User context	**User types**	*Novice users, Expert users*

Figure 1: GI-Usability patterns for map visualization.

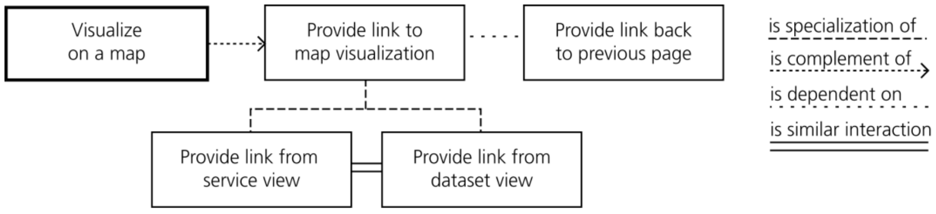
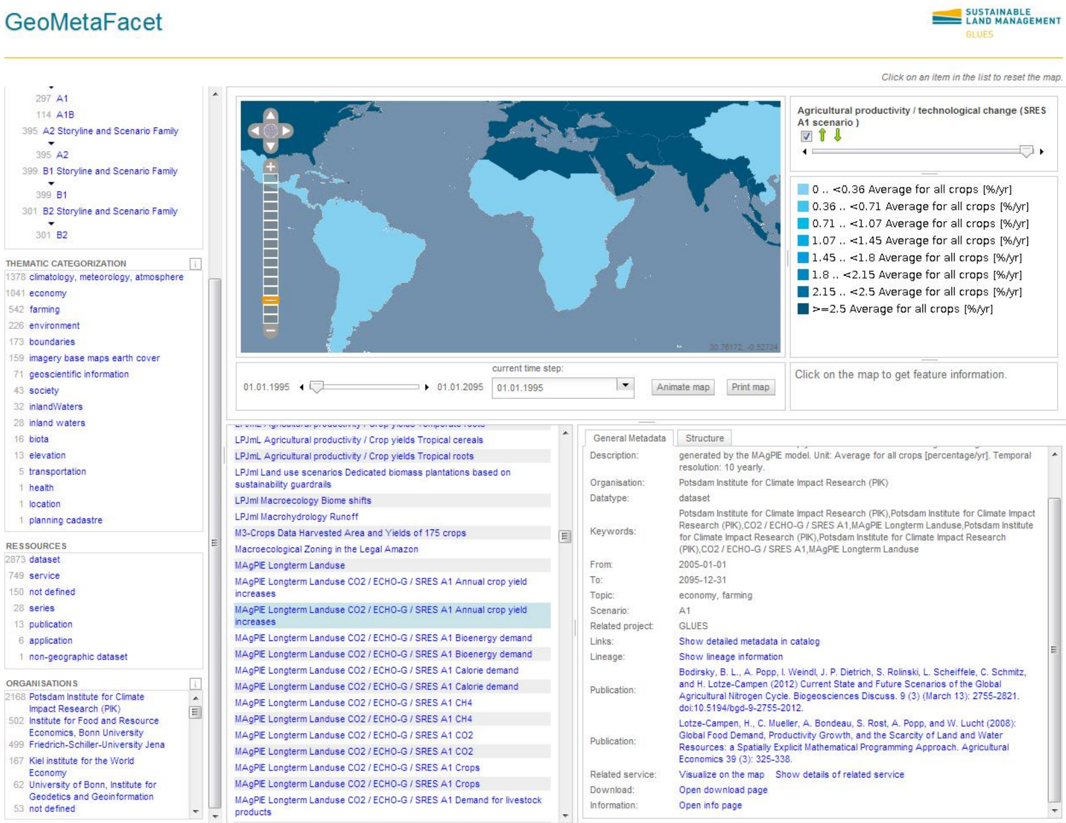


Figure 2: Reference implementation of "Provide map link from dataset view".



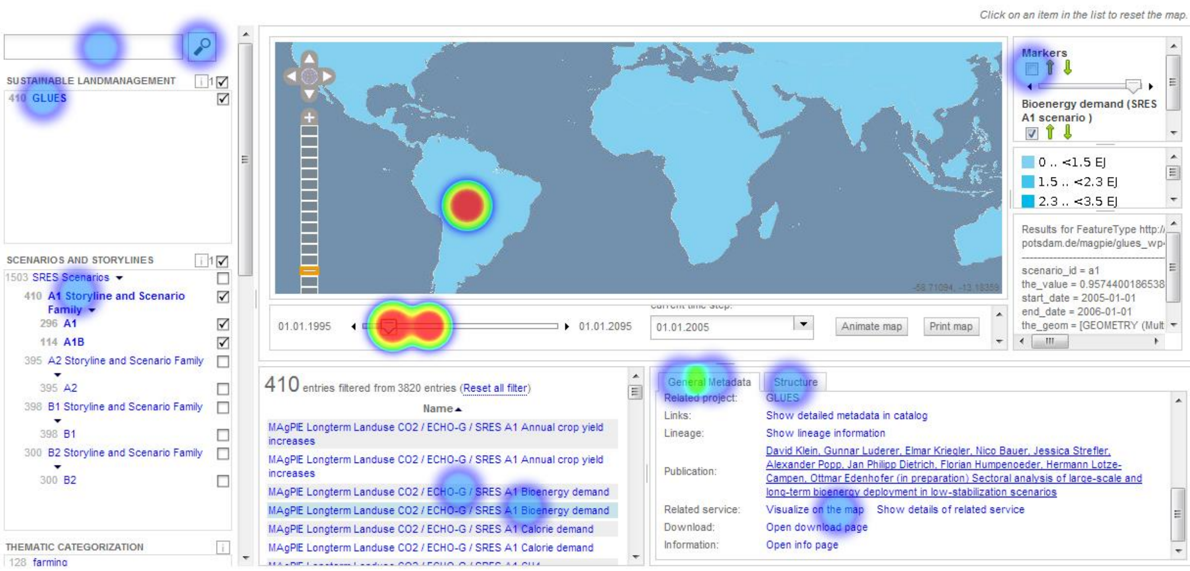
similar interaction" is proposed, to help developers in identifying all patterns which support a particular UI interaction concept.

4 Future Work

The design of GI-usability patterns is laid out as an incremental and iterative process. Having a general concept for GI-usability and related attributes a first set of patterns has been defined. This now builds the basis for further improvement of the pattern structure and thereon the definition of new pattern sets.

The defined GI-usability patterns get prototyped and exemplified in GeoMetaFacet [3], a web-client for the exploration and visualization of geodata (figure 2). This allows for future usability tests (figure 3) to help in establishing measurements for the success and efficiency of the proposed patterns. Therefore future work will investigate into qualitative (e.g. provided by ISO 9241) and quantitative metrics (e.g. eye-tracking or mouse click analysis) for these usability tests.

Figure 3: Heatmap visualization of user interactions – circles visualize mouse clicks (blue – clicked once, red – most frequently clicked).



Detailed descriptions of the patterns introduced here can be found at:

> http://geoportal.glues.geo.tu-dresden.de/giusabilitypattern/index.html

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