

From Task-Oriented to Goal-Oriented Web Requirements Analysis

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Abstract

Task analysis has been used traditionally in HCI and CSCW to define requirements for user interfaces, web-based or otherwise. This paper argues that a shift of paradigm is needed in web engineering from task-oriented to goal-oriented approaches for designing applications delivering a quality user experience and achieving the objectives of the stakeholders. Task models focus on fine-grained and precisely defined user needs, thereby risking a commitment to premature design decisions. Moreover, since task analysis focuses on users doing things with the system, tasks do not capture the goals of other stakeholders who are not users. Goal-oriented methods, on the other hand, provide specific support for coping with high-level users' and stakeholders' goals, facilitates the exploration of design alternatives and the definition of requirements at a suitable level of abstraction. As such, goal-based techniques are more suitable for early stages of requirements analysis; task models can be used for later stages, such as detailed interaction design and usability evaluation. The paper conducts a detailed comparison of task- and goal-analysis design techniques, using an ongoing project for a museum website to illustrate the two techniques and their relative strengths.

Keywords: requirements analysis, stakeholders, goal, task, website design.

1. Introduction

Let us consider the following scenario. An Italian tourist just arrived in Paris with his family has four days to spend in the French capital. He does not want to miss visiting one of the most famous museums in the world and thus manages to find an Internet connection to access the museum website. What would he access the website for? Probably, when asked, even the tourist would not be able to articulate a precise objective for visiting the site: he might just want to see what the museum has to offer, get an idea of how much is there to visit, understand the

variety of the collection hosted, check the visiting hours, gather the elements to plan a visit or maybe he would just be confirmed in the belief that the museum is really worth visiting.

On one hand, a nebulous mix of expectations, ill-defined goals, generic interests and practical needs informs the attitude by which the user will approach the website. On the other, the museum communication department basically conceived the site with the aim of maintaining the prestigious image of the museum all over the world and not disappointing the expectations of its worldwide audience. The museum needs to communicate the well-organized nature of the institution, as well as its proud history and fabulous collection.

Under these circumstances, what are the chances that the user experience will be satisfactory? What are the chances that the communication goals of the museum will be achieved?

Analysts and web designers have to cope with such complexity arising both from the user and the main stakeholders' side, in order to design solutions delivering an effective user experience and meeting the communication objectives. Thus, analysts and designers need systematic techniques to achieve a healthy balance between the consideration of users' and stakeholders' requirements in the development of a website.

With regards to the user side, the heterogeneous family of task-based techniques represents the dominant paradigm for the analysis of user requirements. Basically, the question that task models try to answer is: *What will the user do with the website?* User tasks are envisioned targets of achievement and courses of actions the user might want to accomplish on the website. In this user-centered perspective, tasks are analyzed and decomposed providing an input for the design activity.

A basic premise of Requirements Engineering (hereafter RE) is that all stakeholders, not just users, need to be consulted and accommodated by the system-to-be. Moreover, goal-based RE techniques do so by identifying and analyzing high-level stakeholder goals. Basically, the question that goal models try to answer is: *What are the goals of the stakeholders of the website?* Goals are

analyzed and operationalized into system requirements through a refinement process, whose outputs are fed as inputs to a subsequent design activity.

Whereas a sole user-centered design approach would only study what the user needs, neglecting the needs of the museum, a sole museum-centered approach would instead suggest communicating through the site the key messages of the organization, neglecting the needs and goals of its intended audience.

As websites are increasingly used as communication means and not only as systems for information retrieval, analysis of user tasks should be complemented with the analysis of stakeholders' goals in order to gain a more complete and accurate requirements set. Hence, this paper argues that a shift of paradigm from task-oriented techniques to more comprehensive goal-oriented approaches is needed, to take into account more factors characterizing modern website development. In particular, it suggests the use of goal-based techniques for high-level requirements analysis and task-based methods for the later stages of development (notably conceptual design and usability evaluation).

The rest of the paper is organized as follows. Section 2 illustrates the results of task analysis as applied to an ongoing project of a museum website. Section 3 discusses some limits of task-based approaches for website requirements. In section 4, a goal-based approach applied to the same case highlights the benefits of complementing task with goal reasoning. In section 5, excerpts of the design of the site are showed. A survey of relevant works in different disciplines dealing with user requirements is followed by concluding remarks and the outline of future work.

2. Task-based Analysis

2.1 Task Identification

Task analysis is a general technique used to describe and evaluate the activities required, or believed to be necessary for a user to achieve a goal in an interactive environment [1]. Whereas a *goal* may be defined as a state of affairs that the user wishes to achieve, a *task* is the course of action the user goes through in order to achieve this state.

In website analysis and design, tasks are usually associated to one or more user profiles, which represent archetypal target audiences of the website [10]. Profiles and relative tasks may be defined through scenarios [7], or user research techniques such as questionnaire, direct observation, structured interviews and surveys.

In [21], Shneiderman distinguishes four kinds of user tasks for websites: *specific fact finding* (concerning the localization of identified units of content), *extended fact*

finding (concerning a broader interest), *open-ended browsing* (supporting more complex learning needs), and *exploration of availability* (allowing to check the presence of given topics of interest).

Let us consider an example of task analysis suggested by an ongoing web project for the design of the website for Edvard Munch's Exhibition at the Staatlichen Museum of Berlin¹. Following the proposed classification, user tasks for each relevant user profile may be defined. For example, tasks of the user profile *Tourist* may be organized as follows.

Specific Fact Finding:

- Find the location of the exhibition;
- Find the exhibition visiting hours;
- Find the cost of the entrance;
- Find the starting and ending date of the exhibition.

Extended Fact finding:

- Which Munch's works are exhibited?
- What other authors followed Munch's style?
- Which artistic movements influenced Munch's art?
- What painting techniques did Munch use?

Open-ended browsing:

- Why is Munch famous?
- What are the most important works of Munch, and why?
- Does the exhibition host his most representative works?
- Is the exhibition receiving attention?

Exploration of availability:

- What kinds of works are exposed in the exhibition?
- Are there accessible places to eat close by?
- Are there rooms for kids?
- Is there an exhibition shop?

Tasks have been defined on the basis of previous project experience in the cultural heritage domain, through brainstorming on scenarios with members of the project team and potential users. For other relevant user profiles (e.g. *Journalist*, *Student* and *Art Critic*), other tasks may be identified and classified accordingly.

2.2 Task Decomposition

In hierarchical task-analysis techniques (HTA) [19], tasks are gradually decomposed into subtasks and eventually into actions (also called operations or moves [16]), which define how the user will actually perform the tasks step-by-step.

¹ The website has been designed within the European project "Help", supported by the EC, framework Culture 2000. The site is available at: www.munchundberlin.org.

Task trees may help evaluate paths and alternatives for the user to complete a given task. In our simple example, the task “*What authors followed Munch’s style?*” may be decomposed as shown in Figure 1. [19] provides a similar example of task analysis in the museum domain.

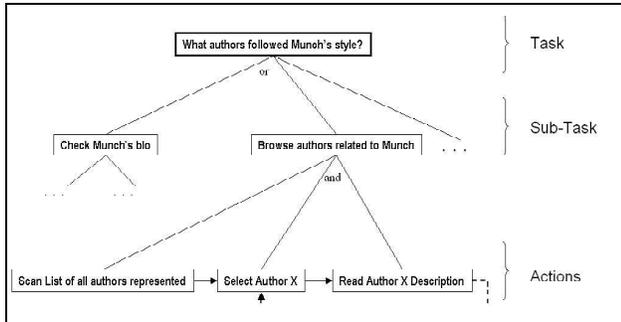


Figure 1. An example of task decomposition.

The flow of envisioned user actions naturally results in website requirements. In the example, the task decomposition suggests that it would be useful to have a description of all authors somehow related to Munch. In each author’s description, there should be enough evidence to explain the relevance to Munch’s art or life. Authors should be organized in a list-wise index to facilitate access and browsing.

2.3 Website Requirements

Once all tasks for the key user profiles have been decomposed, a first draft of the requirements set for the website is gathered (see Figure 2). Requirements are expressed at a sufficient level of granularity to provide an overview of the needed content and indications for information architecture.

| Requirements Set for user profile “Tourist” |
|--|
| News (updated number of visitors and other related events) |
| Exhibition presentation (theme and works represented) |
| Practical information (dates, location, visiting hours, ticketing information) |
| Extended bio for Munch |
| Short bio of relevant authors |
| Index of authors |
| Description of relevant artistic movements represented |
| Index of artistic movements |
| Description of each painting technique and style represented |
| Index of techniques |
| Where to eat and where to stay |
| Kids section |
| Exhibition Shop |

Figure 2. Requirements derived from the task analysis.

Designers can work on these requirements to sketch the detailed content structure, interface prototypes and navigation paths. Content designers in turn can define the map of the content needed for the site.

Finally, tasks may then be used as rich source for planning the usability evaluation on the prototype, either

assigning some tasks to a sample of users or having designers systematically perform all the tasks on the prototype and pointing out usability breakdowns to be fixed in the next iteration [17].

3. Limits of Task Analysis

At first glance, the simple task analysis showed in the example might appear easy to carry out, lightweight and straightforward to understand, and yet quite accurate in identifying user-centered requirements for the site-to-be. However, a closer look reveals some limits to this approach.

3.1 Lack of Support for Ill-defined Goals

Website users often have a vague understanding of the goal of their interaction just because they do not have a precise objective [23]. Anecdotal evidence suggests that an important reason for web users to “surf” a site is simply the possibility of being attracted by something interesting.

In the information retrieval domain, this lack of specificity about user goals is often considered an “anomalous state of knowledge (ASK)”[4]. However, this “negative” definition (anomalous) suggests that the users should have – under normal circumstances – a clear objective and explicit knowledge about the tasks he might want to carry out on the site. This assumption is due to the fact that, during the design of conventional information retrieval systems, user tasks are supposed to be *clearly defined* most of the times; vague goals represent a problematic situation, and one to be reduced as soon as possible to more manageable user tasks.

However, in the web domain, it seems more appropriate to consider imprecise goals as the normal/typical way users approach a website.

Let us think to the website of an online newspaper: users might have well-defined tasks such as *Find a specific article*, *Download a picture* or *Print the editorial*. However, a typical attitude of a user approaching such a site might well be *curiosity*, *expectation of a novelty* or just superficial interest in *What happened today?*. Similarly, a tourist website for a large city should be addressed to first time visitors who expect to be guided in the choice of selecting what is really worth visiting in their period of staying. In this case, user goals are vague, hardly reducible into tasks, and yet their fulfillment is crucial to the user experience.

Also in the case of an educational website, users’ goals may be not precisely defined: for example, first time users need to be *introduced to the course topics*, *have an idea of the material available*, *understand the coherence of the educational path proposed*, and *organize the personal learning activity*. Precise tasks are instead typical of

frequent users who may, for example, use the material for revision: *finding a specific passage in a lecture, locate bibliographical information, retrieve an example, selecting an exercise, etc.*

Organizations are increasingly using websites as a strategic tool for communicating with a variety of user profiles whose goals are not always precisely defined. Whereas the communication strategy of the website acquires growing importance (think of applications such as cultural heritage, education, e-government, institutional, e-publishing, promotional and the like), user needs are not necessarily well-defined in the user's mind in form of tasks. In these applications, users unconsciously and implicitly delegate to the site the responsibility of fulfilling, and even going beyond expectations by prompting new goals in the user's mind.

These goals can be characterized in at least three respects:

1. From the user's perspective they are *unfocused* because they do not state clearly a specific target of achievement for the user experience.
2. From the designer's perspective, they are *ill-defined*, because they are not readily reducible to well-defined tasks to be easily mapped onto interface features.
3. From the main stakeholders' perspective (i.e. from the point of view of the people who conceive the website) these goals are *malleable* because they may potentially change and evolve along the session due to their ill-defined nature, making room for the site communication strategy to affect significantly the user experience.

Ill-defined goals are a special type of *softgoals*, i.e. goals that have no clear-cut criterion for their satisfaction [26]. In fact, whereas a task is satisfied by a sequence of functionalities activated by the user on the interface, softgoals are instead open-ended user needs that may be *somehow* supported by one or more combination of content, navigational possibilities and functionality. The satisfaction of softgoals is nor complete or optimal but rather "good-enough". As such, softgoals need to be treated differently from functional goals. They are elaborated and interpreted by selecting increasingly specific methods for addressing them during requirements elaboration and design process.

Task-based techniques offer little support for capturing, defining and analyzing ill-defined goals, although they do capture a different, but also important aspect of user requirements. Whereas tasks – even when generic and open-ended – can be decomposed in a sequence of fine-grained user actions, ill-defined goals require the designers to take *ad-hoc* strategic decisions balancing the resources available, the stakeholders' communication goals and the overall hypermedia design.

3.2 Missing Stakeholders' Goals

As we have shown, task-analysis is claimed to cover at least some of the user goals with the respect to the website-to-be. What about the business and communication goals of the people interested in financing, publishing, promoting and managing the website?

A purely user-centered approach is suitable for web applications that are not designed to convey a communication potential, but rather to serve exclusively as repositories for information querying or decision-making.

Modern web applications are merging these existing paradigms with the need of addressing communication goals [25], which means establishing a relationship with a variety of target audiences to get across content and structured messages. To this end, goals of all the relevant stakeholders (that are not only the users) should be identified from the outset of the project.

In the museum example, the museum representatives and the decision makers are obviously key stakeholders, but so are the sponsors of the events organized by the museum and all those people having a direct and tangible interest in the success of the website. All the different departments of the museum (communication, shopping, collection, visits, preservation, etc.) want to make hear their voice. They expect that their needs and expectations are taken into account and have an impact on the final design solutions. They are also a valuable source for uncovering user characteristics (e.g. preferences and habits) and the domain knowledge hardly accessible to the project team.

In the museum example, the cultural mission of the site is to make known to the general public Munch's works that are not famous. In fact, a special collection of Munch's drawings (usually not exhibited along with Munch's famous works) has to be known to the public. Besides, the museum communication manager needs to promote the sponsors of the exhibition through the website. In fact, the website can be used to promote the brand of the sponsors to a worldwide audience at low cost. Moreover, the museum wishes to attract new sponsors to gain financial support for current and future events.

These goals will influence the design decisions and have to be integral part of the requirements analysis. As such, a *stakeholder-centered* development should subsume a *user-centered* approach.

3.3 Preventing Exploration of Alternatives

An important objective of requirements analysis is to allow analysts to explore different design alternatives without committing prematurely on given design solutions [7]. In fact, anticipated solutions may be wrong or not the

most adequate to fulfill the identified goals. However, given the complexity, indefiniteness and volatility of both users' and stakeholders' goals, it is often difficult to analysts to find a healthy balance between the exploration of alternative design strategies and the ossification on an envisioned design artifact.

The task decomposition provided in the museum example (Figure 1) assumes that a number of design decisions have already been taken. Notably, they can be summarized as follows.

Information about authors relevant to Munch is available. This assumption about the site content is not necessarily true. During requirements analysis, analysts have to wonder whether it would be effective (in term of budget and time constraints) to include this information in the content design. It is known that content is the most valuable but also the most costly asset of a website. Therefore, the analyst should be very careful not to take for granted that a piece of content is available and can be delivered by the stakeholders. An alternative design strategy to be considered might be to just enrich Munch's bio with the description of artistic influences. Or, to reuse the descriptions about the artistic movements represented in the museum (of which Munch's exhibition is part) to support the user task.

The site presents a separate description page for each single author. This design decision concerns the structure of content and, as before, it is assumed in the task analysis. Alternatively, the site might offer only one overall description for the authors related to Munch, instead of detail bios of each single artist.

All authors are organized in an index navigation pattern. Different navigation patterns can be designed [18] to support different user needs. It should not be taken for granted that an index of all authors will allow any user to accomplish effectively her task. The index is suitable for experienced users who might want to locate a specific author in a set. However, a first time user (who does not know any of the author mentioned in the index) needs to be introduced to the collection of authors and might want to have a guided overview of the authors that influenced Munch's art. A guided tour pattern [18] in this case would be a better navigation design alternative.

As shown by these examples, task decomposition used in isolation does not facilitate the exploration of high-level design alternatives. Taking into account the needs and goals of the stakeholders, the constraints and the complexity of user profiles, problematic assumptions can be uncovered and discussed, paving the way for a requirements set that is better rationalized.

4. Goal-Based Analysis

4.1 User's Goals

Whereas task analysis focuses on user interactions and the actions needed to carry them out, *goals* in RE model desired states of affairs for the users that do not commit on premature design solutions and do not depend on given style of interactions. In this respect, goal-based RE provides specific support for reasoning with stakeholder and user goals.

Goals have, in comparison to tasks, a broader scope and a coarser granularity. The breadth of scope is a direct consequence of the fact that goals describe desired states of affairs that transcend the boundaries of the interaction with the application.

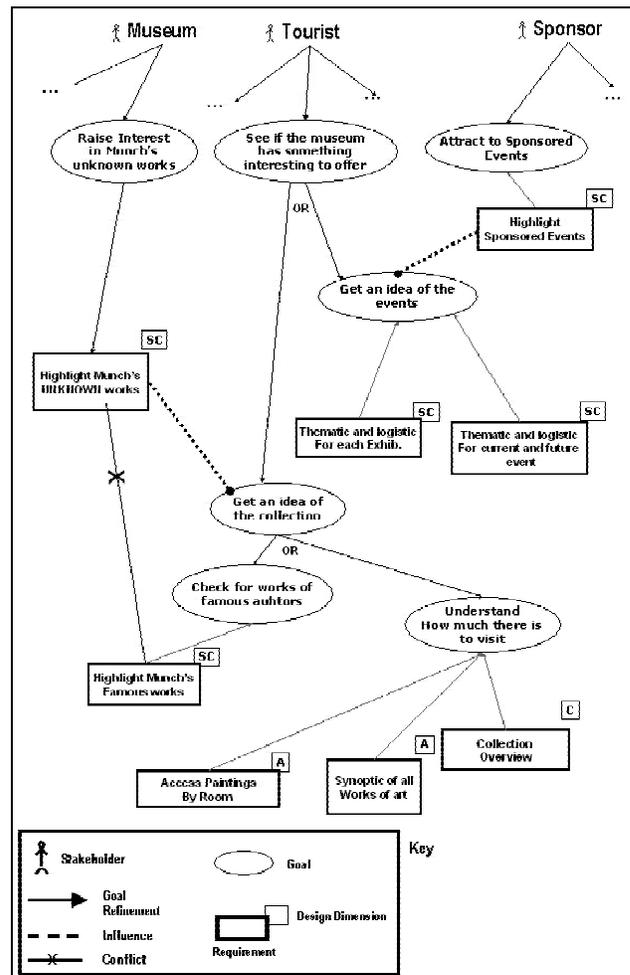


Figure 3. An example of goal analysis.

Get an idea of the collection is a goal that – due to its indefiniteness – will be probably *partially* satisfied by interacting with the website. The fulfillment of this goal may be brought to completion through other means available to the user (e.g. browsing other sites, news stories, asking a friend, reading a museum catalogue). Instead, a *task* such as *Find painting X* is an activity

whose completion may be more easily confined within the boundaries of the interaction with the website. Besides, goals have also coarser granularity than tasks because they are not directly concerned with the site features.

A goal-oriented approach was adopted in the project to complement task analysis and overcome the limits previously illustrated. For our study, we used the AWARE goal-oriented notation for web requirements [6], that is an extension of the *i** modeling framework for early requirements [26].

Let us consider the user profile *Tourist* analyzed in a goal-oriented perspective (see Figure 3). One of the tourist goals is to *See if the museum has something interesting to offer*. This ill-defined goal is extremely relevant for first time visitors of the museum, especially if they do not know the importance and the value of the museum and would like to get an idea about it.

4.2 Goal Refinement

Through a refinement process, high-level goals are broken down in sub-goals through AND-OR decompositions. OR relationships allow exploring alternatives for the user to achieve a goal. For example, in order to *See if the museum has something interesting to offer* the user might want to *Get an idea of the collection* or to *Get an idea of the events organized by the museum*.

Subgoals may be refined into tasks and eventually into requirements. Whereas goals represent targets of achievements for the user, requirements are the leaf nodes of the decomposition graph and represent indications for web designers. In the example (see Figure 3), to *Get an idea of the collection*, the user might want either to *Check for works of famous authors* or *Understand how much there is to visit*. The requirement identified for the former goal is to *Highlight Munch's famous works*. Three other requirements have been defined to support the latter goal: *Access painting by Room*, *Synoptic of all works of art*, *Collection overview*.

These requirements do not yet define an interaction flow of user actions (as task analysis would suggest); they describe the high-level website capability needed to support user's goals.

The requirements defined can be prioritized and pruned according to the goal alternatives selected. In fact, it is not given for granted that it is possible to support all alternatives within the time and budget available of the project.

The refinement process is supported by the envisioning of salient scenarios [7]. Together with the museum stakeholders and the design team, user goals have been defined on the basis of plausible situations of use of the application, envisioning the user experience in context. Brainstorming by means of scenarios helped

justify the refinement process and elaborate goals into requirements.

4.3 Organizing Requirements

In order to provide an organized input to the design activity, requirements are classified by design dimension. A dimension represents the design aspect a given requirement will have an impact on. Dimensions may be Content (labeled with C); Structure of Content (SC); Access Paths to Content (A); Navigation (N); Presentation (P); User Operation (U); System Operation (O); and Interaction (I). For detailed definition of the web requirements dimensions we remind to [5]. In Figure 3, the label attached to each requirement identifies the dimension the requirement belongs to.

The result of the refinement process may also identify *non-functional requirements*, i.e. requirements that do not specify any functionality but rather a *property* the website should meet. For example, an important non-functional requirement concerning the content is the *site versioning for multiple languages* (e.g. German and English). Examples of non-functional requirements concerning the presentation aspect may be: *Provide high-quality images of the works*, *Design a young layout style for the kid's section*, *Design a professional and attracting style for the collection section*. An example of non-functional requirements concerning the usability of the navigation may be *Provide consistent navigation patterns*.

Traditional task analysis does not capture non-functional requirements because they do not represent interaction steps necessary to the completion of a task. However, they are crucial for the overall quality of the user experience.

4.4 Stakeholders' Goals

As pointed out in Figure 3, goal analysis, besides taking into account ill-defined goals, broadens the spectrum of requirements to be considered by analyzing goals of the other relevant stakeholders: notably, the museum communication manager and the exhibition sponsors.

In fact, an important mission of the museum website is to raise interest in the general public about Munch's works that are not famous but have a substantial artistic value. This goal, among others, has been refined into a requirement concerning the structure of content of the website: these works unknown to the general public should be *particularly highlighted* in the museum website. It would be up to the designers interpret, decide and negotiate (with the analysts) what this "highlighting" means. They will decide how to solve this requirement

taking into account the economy of the overall site structure.

Museum stakeholders' goals are key in the web development process because they express the reason for which the website exists. If main stakeholders' goals are not met or reflected in the design, the website will not fulfill the objectives it has been made for. In fact, there would be no reason to build a usable service (*user-centered*) useless to the organization (not *stakeholder-centered*).

4.5 The Requirements Set

By envisioning goals for each user profile and for each relevant stakeholder, a more complete set of requirements was identified than the one resulted by the task analysis.

Figure 4 shows the requirements set defined after the analysis of the goals of the user profile *Tourist* and the stakeholders *Museum* and *Sponsors*. Figure 4 may be compared with Figure 2.

| Requirements Set for User Profile "Tourist" | |
|---|---|
| | CONTENT |
| √ | where to stay |
| √ | where to eat |
| √ | provide details how to reach |
| | exhibitions up to date |
| √ | visiting hours |
| √ | provide explanation of each painting |
| √ | description of each painting technique represented |
| | suggested visit paths |
| √ | news |
| | details of available tours |
| | events up-to-date |
| | collection overview |
| | show sponsor brands |
| √ | extended bio of munch |
| √ | short bio of relevant authors |
| √ | description of the artistic movements represented |
| | contacts of the visit office |
| | multilingualism (english, german) |
| | STRUCTURE OF CONTENT |
| | highlight munch's unknown works |
| | highlight munch's famous works |
| | highlight important events |
| | highlight sponsored events |
| | time expected for each visit path |
| √ | thematic and logistic info for each exhibition. |
| | thematic and logistic for current and future event |
| | highlight artistic relevance of the collection |
| | PRESENTATION |
| | provide good-quality images |
| | design a young style for the kids section |
| | design a professional but attracting style for the kids section |
| | keep style consistency across sections |
| | ACCESS TO CONTENT |
| | access paintings by room |
| | access paintings by theme |
| | synoptic of all works of art |
| | organize events by past, current and future |
| | USER OPERATION |
| | post request for a reserving guided tour |
| | NAVIGATION |
| | relate sponsor brand to sponsor external website |
| | relate each author to his paintings |

Figure 4. Requirements derived from the goal analysis. Checked requirements are the ones already identified through the task analysis.

The set of classified requirements represents the actual input for the design activity. Designers can then adopt any model for conceptual design (OOHDM [13], UML [9], WebML [8], HDM [12], W2000 [3], etc.) to shape design solutions solving the requirements.

In fact, the hypermedia taxonomy of requirements is suited to serve as basis for design approaches that acknowledge the importance of separation of concerns in the design process (e.g. information design, navigation design, presentation/interface design, operation design). However, less-structured approaches and more straightforward design techniques (e.g. storyboarding, rapid prototyping) may also be used to elaborate requirements into design.

4.6 Identification of Conflicts

The goal graph in Figure 3 points out that the requirements *Highlight Munch's unknown works* clearly conflicts with *Highlight Munch's famous works*, needed to support the user to get an idea of the collection and decide whether the museum is worth visiting.

The identification of the conflict (represented by a crossed line) helped designers to reflect on possible design strategies accommodating both requirements, thus fulfilling the stakeholder objectives *and* supporting the need of the users. In fact, the requirement *Highlight Munch's unknown work* will have an effect (represented by a dashed line) on the user goal *Get an idea of the collection*. What this effect will be, it depends partly on how designers will solve that requirement. On one hand, the requirement *Highlight Munch's unknown work* might be an obstacle to the initial goal of the user, who expected to have the chance to see famous works. On the other hand, depending on how the unknown works will be introduced and presented (for example explaining their richness and artistic uniqueness), the user might become intrigued and interested in exploring them. Usability evaluation techniques may then help evaluate the actual effectiveness of the design decisions on the user experience.

Another important requirement issue arises when the tourist goal *Get an idea of the events* meets the sponsor goal *Attract to sponsored events*. A requirement descending from the latter is *Highlight Sponsored Events*. This requirement has an impact on the tourist choice of seeing interesting events and selecting the events to attend. Depending on how designers will solve this requirement, the user goal *Get an idea of the events* might be more or less affected by the sponsor's will to push events promoted by its brand.

5. Design Examples

We have no space to show all the design documentation for the website. However, for sake of completeness and to give an idea of the size of the application, let us consider a small excerpt of design, defined on the basis of the requirements gathered and pruned through the goal analysis. In our study, we use the W2000 user-centered design model [3][24] to define the information structure, the navigation architecture and the page design of the website. In fact, W2000 enables to design the web application at three levels: information design (organization of content), navigation design (definition nodes and links) and publishing design (logical design of the pages). For a detailed description of the W2000 design notation we refer to [24].

With regards to the information design, Figure 5 shows an excerpt of the hyperbase, that is the overall conceptual schema of the main information objects (“entity types” in W2000 terms) available to the user.

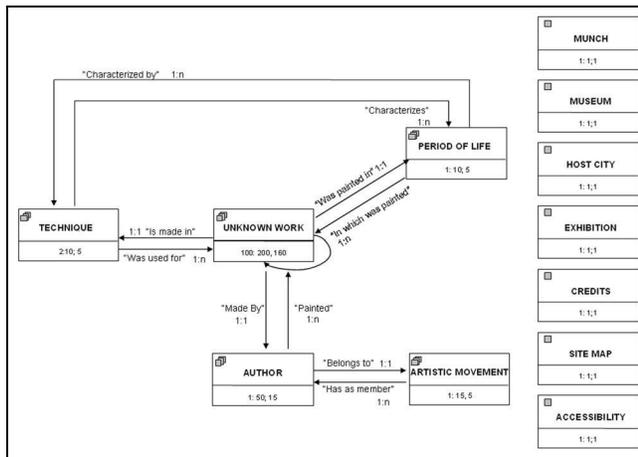


Figure 5. Information design: hyperbase.

The information design should define also the main access structures for the user to locate the content (“collections” in W2000 terms). Figure 6 shows the synoptic of some access structures for the website.

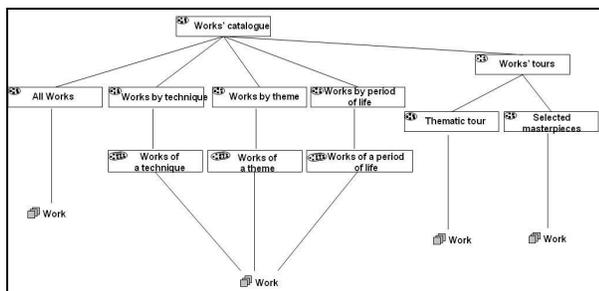


Figure 6. Information design: collections.

To solve the requirement *Highlight Munch’s unknown work* a rich set of collections for the works of art has been designed. Guided tours and the presentation of the variety

of the works might raise in the user the interest of exploring them, although they might not correspond to the famous works users expect to find.

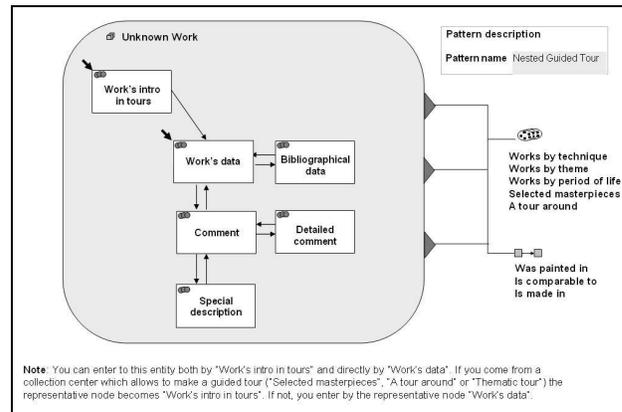


Figure 7. Navigation design: structural cluster.

For each complex information object, we can define the internal navigation structure between the different nodes composing it (“structural cluster” in W2000 terms). Figure 7 shows the structural cluster of the entity type *Unknown Work*.

On the basis of the information and navigation structure, the design of the page templates (“page type” in W2000 terms) is defined. Figure 8 shows the page type for the node *Works data* of the entity type *Unknown Work*.

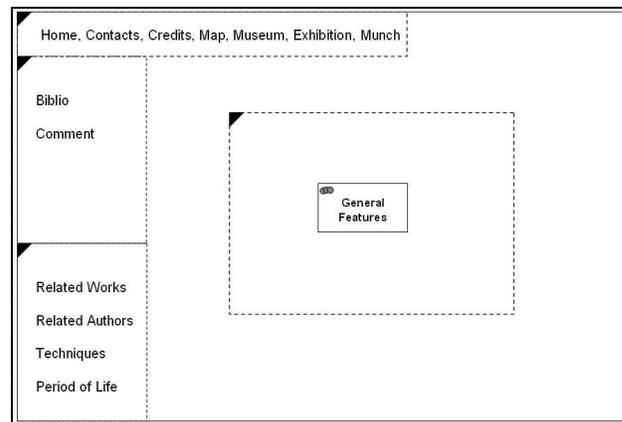


Figure 8. Publishing design: page type.

On the basis of the publishing design, a prototype of the pages was implemented as mock-up for a first usability review. Figure 9 shows the page prototype for *Works data*.

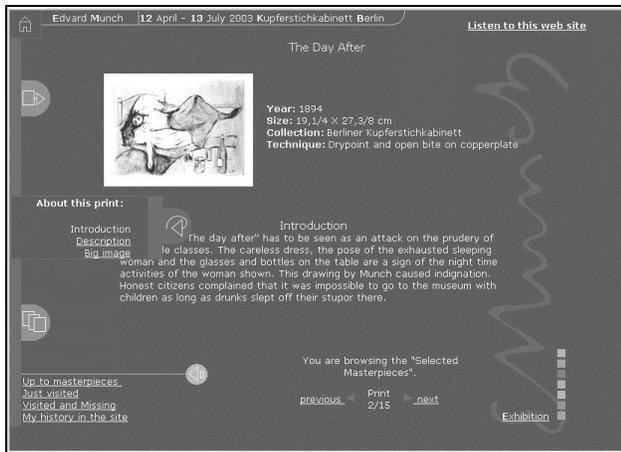


Figure 9. Running prototype for the node 'works data'.

6. Related Works

The term "task" and "goal" are often used indistinctively. In several disciplines dealing with user interaction modelling these concepts have been explored assigning to them different meanings.

Web practitioners acknowledge the need for focusing on user *and* stakeholders goals before carrying out traditional task analysis. In this regards, Cooper states that goal-directed@design should guide the development process: whereas goals are what the stakeholders might want to achieve, tasks are the technological means to accomplish them [10].

Task analysis is highly regarded in HCI (Human-Computer Interaction) and IR (Information Retrieval) research domains. A variety of different task-based techniques has earned broad acceptance among researchers and practitioners. The GOMS (Goals Operators Methods Selections) family of techniques [14] offers rich tools for analyzing user tasks for an interactive system. The kind of tasks addressed in GOMS describes fine-grained, operational concerns decomposed in sequential or parallel activities.

The seminal work of Shneiderman [21] defines the Objects/Actions Interface model for website design, where user tasks concerning given domain objects are mapped to user actions manipulating interface features. Marchionini [16] provides insightful evidence about the complex definition of user goals and tasks in information seeking scenarios. He acknowledges that user tasks vary along three continua: specificity, quantity and temporality.

More recently, task models for user-centered website design have been developed [19]. User tasks are specified through a diagrammatic notation (e.g. ConcurTaskTrees [19]) that allows envisioning user interaction with the application and deriving information, navigation and

presentation design accordingly. Complex user tasks for information systems supporting decision-making have also been explored [1].

These approaches focus primarily on the user perspective and are applied to applications (including web-based ones) serving mainly information seeking, or decision-support systems. In these scenarios, the agents involved are usually a repository of information (provider) and the users. However, since organizations and institutions use websites as mean to communicate [25] and to establish strategic relationships, analysts need to capture also the goals of the different stakeholders in the requirements picture.

In RE (Requirements Engineering), goal-oriented approaches such as KAOS [11], GBRAM [2] and *i** [26] provide support for identifying stakeholder, system and user goals. Goals are elaborated and "refined" into low-level requirements, which are the actual input for the software design activity. In particular, *i** enables modelling early requirements by identifying the actors (users and main stakeholders) involved, their goals, their dependencies, and the rationale for their intentions.

7. Concluding Remarks

We have compared two techniques for developing requirements for websites. Figure 10 summarizes the key findings of the study. The comparison was conducted through an example abstracted from a (real) case study. The example – focusing on an information-intensive website - indicates that goal-oriented analysis is coarser-grain than task-oriented analysis.

| Modelling Concern | Approach | |
|----------------------|--|---|
| | Task-Oriented Analysis | Goal-Oriented Analysis |
| Actors Described | Users | All relevant stakeholders |
| Analysis Focus | Precisely-defined user interactions | Stakeholder goals, ill-defined user goals, conflicts identification |
| Analysis Process | Tasks are decomposed into user actions, that are fed into design | Goals are decomposed into subgoals and tasks to define the requirements for the website |
| Alternatives | Task alternatives for the user | Goal alternatives for the stakeholders and design alternatives for the designer |
| Granularity | Design level | Requirements level |
| Input | User scenarios and user research | Scenarios, stakeholder research and organizational analysis |
| Output | Description of user profiles and associated tasks | Description of stakeholders and associated goals. |
| Format | Task diagrams | Goal graphs |
| Activities supported | Interaction Design, Usability Evaluation | Requirements Analysis |

Figure 10. Tasks and goals: summary of the comparison.

Goal-oriented analysis can be used in early phases of requirements analysis to capture user and other stakeholder needs and wants that may be ill-defined and unstructured. Task-oriented techniques, on the other hand,

can be used in later stages to capture precisely defined user interactions. Both task- and goal-oriented techniques are lightweight and kept informal, to be easily integrated in an iterative development process, typical of websites [15].

Future research will focus on the validation of the goal-oriented approach to requirements using large web projects. Heuristics for analyzing ill-defined user goals and patterns of refinement for recurrent stakeholder goals in a given domain will also be explored.

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