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User Requirements Acquisition for Museum Hypermedia

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Abstract

As in many complex interactive applications, the quality of a museum hypermedia is strongly related to how well it matches the requirements of its potential users. In turn, this is strictly dependent upon the developer's ability of understanding user characteristics and contexts of use, and of "translating" such properties into appropriate design choices. Since museum hypermedia has a large variety of potential users, understanding what they really expect from the application is a complex expensive task, and much information must be gathered and analyzed: users knowledge of the application domain; their previous experience with hypermedia; the specific tasks they need to perform; and the physical and temporal situation of use. In this paper, we propose a method, called W5+, which supports a systematic and well organized way of collecting and analyzing user requirements of museum hypermedia, and report experiments of use of W5+ for user requirements acquisition, performed in ten museums in Milan.

1. Introduction

Museum hypermedia typically have a large variety of potential users, who have different needs and expectations, and may require different content and different ways to interact with the system. To improve the usability and utility of the final application, it is important to understand user requirements precisely, and to translate them as much as possible in the design of the system (Troeyr 98, Garzotto 98).

Analyzing users requirements for a museum hypermedia is a difficult task, since an application of this kind potentially addresses many different categories of users, and several aspects should be considered for each category, e.g., the "intrinsic" characteristics of users (e.g., their knowledge about the museum subject and their previous experience with computer applications), the specific tasks they need to perform with the system, the scenario of use (Sarini 98, Kobsa 98, Vassileva 96).

Unfortunately, the relevance of user requirements is oftentimes underestimated in museum hypermedia projects, and usually only limited efforts are invested to define them. The process of user requirements acquisition and analysis, when it is done, is performed roughly and approximately; the results are reported to designers in a confused and unstructured way. As a consequence, the final design often tends to ignore the real needs of end users, or to understand them at a too late stage of development, when revising design choices become unfeasible and too expensive. One reason is that clients and developers are often more worried about requirements of other nature, concerning technology for example, which are surely as important as user requirements, but impact on application development under a different perspective. Another reason is the lack of methods to support user requirements definition in general, and for museum hypermedia in particular. Although software engineering has developed a number of techniques for "generic" software systems, these methods do not pay much attention to user requirements (rather focusing on system related requirements) nor they provide specific guidelines that take into account the peculiar aspects of hypermedia, and in particular hypermedia for museums.

To address this problem, we have developed a methodology called "*W5+ model*" which intends to support a systematic, well-organized process of user requirements definition for museum hypermedia. This paper provides an overview of the overall W5+ approach (section 2) and then focuses, for lack on space, only on requirements acquisition, which represents the initial phase of the process of requirement definition (section 3). In section 4, we discuss an experiment to test W5+, presenting the results of interviews with the curators of ten museums in Milan. Section 5 draws the conclusions and outlines the directions of our future work.

2. Overview of W5+

W5+ is an extension of the precedent *W5* model for hypermedia user requirements definition, developed at HOC, Hypermedia Open Center, of Politecnico di Milano (Garzotto 97). W5 attempted

to answer the question: "which are the key information that must be understood about users in order to design a useful and usable hypermedia?" It did so by decomposing this general question in a number of sub-questions, represented by the five "W" in the model acronym: *Who? Why? What? Where? When?*

Who addresses the issue: "Who are the intended users of the application?"

Why asks about user motivations: "Why would the user presumably use the system?"

What concerns the expected information content: "What are topics of interest for the user?"

Where addresses the physical context of use: "Where is the system going to be used?"

When investigates the temporal properties of usage sessions: "How long the system will be used in the different situations?

The weakness of the W5 model was in the generality of the proposed questions, and in the lack of operative guidelines, i.e., how to pose the various questions and how to use the collected information to achieve a well-organized, consistent set of user requirements.

To overcome these limitations, the new version of W5, named W5+, decomposes the five W-questions in a number of more specific sub-questions, at different levels of abstraction, and also addresses the issue of how they can be used to collect and analyze the resulting information. W5+ includes a *process model* (depicted in figure 1) which focuses on the first two interrelated phases of user requirements definition, *requirements acquisition* and *requirements analysis*, and distinguishes among a number of activities within each phase. The acquisition phase is intended to gather "raw information" concerning user requirements; the analysis phase is intended to identify the relevant issues among the collected data, and to organize and to filter them in order to get to the definition of a consistent, well structured requirements base. The output of requirements analysis is the input for the specification phase, which is outside the purpose of W5+, since it can be done using standard software engineering techniques. During specification, requirements are represented in some formal or semi-formal language and such descriptions are finally given as input to the design phase.

The general aspects of user requirements acquisition and requirements analysis are described shortly in this section, while the rest of this paper focuses, for lack of space, only on the acquisition phase and on examples of use of W5+. The detailed description of the analysis phase can be found elsewhere (De Silvestro 99).

Figure 1. The process of user requirements definition in W5+

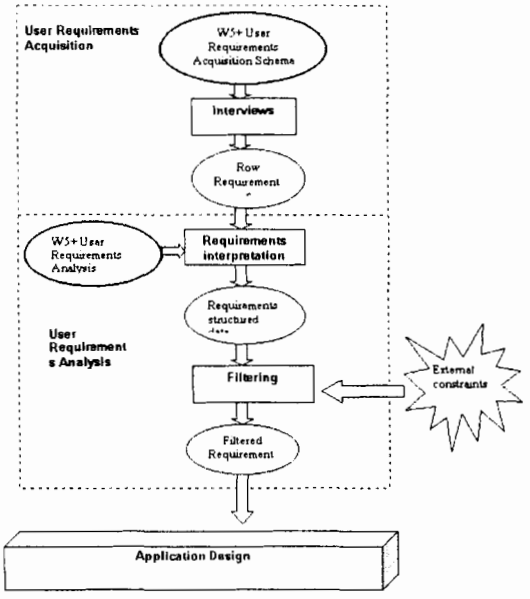

Figure 1. The process of user requirements definition in W5+

2.1 User Requirements Acquisition

Two main approaches are usually proposed for gathering user requirements. One consists of interviewing the application "clients" who commissions the application (e.g., the museum curator(s)), and, possibly, also potential end-users. Interviews can be done interactively, by arranging question-answer sessions, or "batch", by requiring the interviewed people to fill in a questionnaire. In both cases, the effectiveness of the approach is strongly dependent upon the quality of the questions posed to the interviewed persons, i.e., their completeness with respect to the information that must be collected, and their organization (a badly organized questionnaire may lead to confusion and misunderstandings in the persons who must answer it).

A second approach is based on user observation, which consists of observing and recording user

behaviors and reactions during the use of a system similar to the application which must be developed. This method has a number of drawbacks. It is difficult to obtain a system that is similar enough to the application that must be built. Even when this problem is solved, it is difficult to properly select a correct sample of the user community and to reproduce actual situations of usage, i.e., the physical and temporal context where the application is going to be used. An incorrect user sample or failure to reproduce real-life situations may lead to wrong perceptions about the user needs, opinions, and motivations. Finally, the cost and the time to set up reliable observation sessions may be significant (much higher than the interview-based method).

Clearly, the best results can be achieved by combining these two techniques—user observation and interview—since one can provide information that can be missed by the other. Still, their combination can be unfeasible with the time and cost constraints of an average hypermedia project for museums. The W5+ model focuses on the "cheap" interview-based method, and helps analysts perform interviews in a systematic, cost-effective way. W5+ proposes a framework for user requirements acquisition, based on a *user requirements information schema* and a *questionnaire schema*. In the user requirements information schema, the information that needs to be collected about users are classified "by dimension" and "by level". The questionnaire schema provides an organized set of questions that should be asked in order to fill in the information schema with all relevant data for each dimension and level. The W5+ framework also distinguishes among information which represent the client perspective and therefore must be collected by asking the client only, and information which can be asked to the client and potential end-users.

The result of the acquisition phase is an organized collection of answers, structured by dimension and by level, that represent the "raw requirements" given as input to the analysis phase.

2.2 User Requirements Analysis

During the analysis phase the answers collected during the interviews are analyzed and the analyst gives a clear, compact, consistent formulation to row requirements. During this phase, the analyst performs two main activities. One, called *interpretation activity* in figure 1, consists of translating row requirements into a set of qualitative data, organized according to a fine-grained set of parameters defined by W5+ and called *analysis schema*. This schematic formulation helps analysts verify the completeness of the collected information, and to detect potential conflicts among different answers. If problems of inconsistency or missing information are found, the analyst should solve them by performing additional acquisition sessions. Thus the acquisition and the analysis phases do not run as strictly subsequent steps but may involve in a circular process of progressive acquiring and analysing user requirements. In figure 1, this is indicated by the arrows outgoing from the "interpretation activity" box in the analysis phase to the "interview" box in the acquisition phase.

Once a complete and consistent set of user requirement data is produced, the following activity in the analysis phase consists of *filtering*, which considers the actual feasibility of user requirements. During this activity, user requirements are analysed in light of requirements of different nature, denoted as "external constraints" in figure 1 since they are external with respect to pure needs of end users. External constraints are related to aspects such as project resources limitations, time schedule, technological constraints, and similar. For example, it may turns out that some content identified as needed during requirements acquisition cannot be included in the application due to unaffordable copyright costs. Or it may happen that all the functionality required for all categories of users cannot be developed, since the project would become too big with respect to the actual resources allocated for development. External constraints might not be totally clear during user requirements collection, and are outside the purpose of W5+. W5+ only prescribes that before delivering the actual set of user requirements, these must be cross-checked with external constraints, and eventually filtered, selecting only the user requirements which are coherent with them.

3. The W5+ framework for User Requirements Acquisition

As we mentioned in the previous section, the W5+ framework for user requirements acquisition includes a *user requirements information schema* and *questionnaire schema*. In the user requirements information schema, user requirements information in organized in five classes, or *dimensions*, each one corresponding to a different "W":

- information describing the "objective" user profile (Who)

- information describing the client motivations for building the application, and the user motivations for using it (Why)
- information concerning the application content (What)
- information concerning the context of use (Where)
- information concerning the temporal aspects of usage sessions (When)

Within each dimension, information is organized in a number of levels, each one corresponding to different degrees of abstraction and detail.

The user requirements information schema is shown in the following table.

At level 1, we find information that define the *general aspects* of the application: the application purpose (e.g., informative, educational, promotional, ...), the general group(s) of intended users (e.g., museum visitors, students, ...), the application domain (e.g., art, history, science, ...) and the general context of use in its spatial and temporal characteristics (e.g., the museum during a visit, home in the free time, school during a lecture, ...).

These issues should be understood at the very beginning and partially constrain any further choice. Slots at deeper levels describe more specific information, i.e., progressive refinements of the general aspects of the application described at level 1. These will be described later in this section, while discussing the related questions that represent the questionnaire schema.

The questionnaire schema is the operational counterpart of the information schema. For each slot in the information schema, it provides a number of questions that can be asked during the interview(s) in order to obtain the information corresponding to that slot.

Although W5+ does not prescribe a strict order to put such questions, it suggests to start from all questions at level 1, and then to proceed to more detailed issues, top-down along each of the five dimension, in the following order: 1. Who, 2. Why, 3. What, 4. When, 5. Where. The rationale of this "stratified" approach is to provide a set of guidelines to perform the interview sessions, in order to focus the collection activity and to achieve a complete, consistent set of information about user requirements in a shorter time. Interviewed persons tend very often to jump from one issue to another, to stray from the point, sometimes even providing conflicting information. Thus it is important to keep the interview within a precise frame, addressing the principal and most general issues first, and then progressively specialising the investigation, through a set of more and more detailed questions. The problem is that sometimes the different issues are interrelated. For example, the motivations of use (Why) usually impact on the actual content (What), and should be asked first, but the physical situation of usage (Where) may affect the probable duration of usage sessions (When) and the tasks the users can perform (Why) both asked before. For instance, an application located in the library can be used for a longer time and for more complex tasks than one in a crowded and noisy museum entrance. Still, an interview (either interactive or "batch") is intrinsically linear in time, and an order must be suggested, to help the analyst carry on an

	Who	***Why***	***What***	***When***	***Where***
level 1	*general user categories*	*application purpose (client perspective)*	*general domain*	*operational context*	*physical context of use*
level 2	user groups (subcategories)	application-specific purpose (client perspective)	knowledge sources	session frequency and duration	context characteristics
level 3	groups/ subcategories characteristics	application purpose (user perspective)	macro-content by user category/group		
level 4		user specific tasks	micro-content by user category/group		

Table 1. User Requirements Information Schema

interview, or to elaborate a questionnaire, more precisely. This does not prevent the interviewer or the interviewed persons to return back to previous questions when they are stimulated to do so by the answers given to other following questions.

In section 2, we mentioned that interviews can be done to the application "clients", i.e., the representatives of the institution who commissions the application (e.g., the museum curator(s)), or (better) to clients and potential end users. Our experience is that the best candidates for being interviewed are domain experts who has some real experience of museum users and some sensibility of their actual needs (e.g., museum curators), or actual representatives of the consumers of museum contents (e.g., museum visitors, museum curators, domain experts, etc.). Purely technical persons are very useful to understand requirements of different nature, i.e., technological constraints, but may not have the right perception of the needs of real users.

W5+ distinguishes among user requirements of the client, and requirements that can be investigated with the client and end users. Some questions in the W5+ questionnaire are specifically devoted to the client, since they ask for information that only the client can provide. Others can (should, costs permitting) be put to the client and to potential end users. The questionnaire schema includes explicitly the indication of who (client/users) could provide a given kind of information. The formulation of questions should be slightly different in the two cases. For simplicity and lack of space, we provide here the "the client" formulation, leaving to the reader intuition the "exercise" of adapting them for users.

Since the description of the information and questionnaire schemas is too large to fit schematically in one page, the rest of this section describes them dimension by dimension. We will discuss a table for each dimension in which the first column corresponds to the information schema slots of that dimension, the second column lists the corresponding questions, and the last two columns are used to indicate whether a requirement can be acquired by asking the client, or client and user.

Information in the *Who* dimension (first column) is intended to characterize the application target-users in relation to their "objective" characteristics ("objective" in the sense that they can be characterized by visible or measurable factors, as opposed to more "subjective" characteristics such as "motivations for using the system" which are described under the "Why" dimension). This information is useful to guide the discovery of most information in the following dimensions, since many of the What, Why, Where, When questions will be asked in relation to each user category or group.

The first issue, at level 1, concerns the definition of the general user categories in the wide range of potential users, e.g., museum real visitors, potential visitors, researchers in the application domain, etc.

The second issue, at level 2, identifies the possible presence, within each user category, of smaller groups (e.g., in relation to their way of using the application or to their interest in the application content, or to some special constraints that they have, such as physical handicaps). For example, within visitors, we may consider the group "experts in the museum topics", the group "adult casual visitors", the group "kids" etc.

Information schema slot	***Questions***	***Client***	***User***
level 1 *general user categories*	Q1 Which are the general category or categories of expected users?	☺	
level 2 *user groups* *(subcategories)*	Q2 Within each category, are user groups that should be considered different?	☺	
level 3 *groups/subcategories* *characteristics*	Q3.1 What is the level of domain knowledge for each user category/group? Q3.2 What is the level of computer expertise of each user category/group? Q3.3 Are there any other relevant user category/group characteristics?	☺	☺

Table 2. Who

At level 3, each one of these categories/groups is characterized in terms of its relevant features. Two main aspects are addresses - the user general knowledge of the application domain, and his/her computer expertise, but other user characteristics can be acknowledged as relevant (e.g., age, sex, social background). User domain knowledge impacts on the complexity of the content that must be provided in the application (as analysed in the What dimension). Computer expertise in crucial for design, to determine the complexity of the application functionality and the interface style.

Questions at levels 1 and 2 mainly concerns the client, since they are strictly related to his/her motivation for building the system (as described in the Why dimension at level 1). Questions at level 3 can be answered both by the client, and, up to reformulation, to users as well.

The *Why* dimension describes the motivations for building the application, from the client perspective, and for using it, from user perspective.

Level 1 defines the general purpose of the application, as it is viewed by the client. Question Q1 suggests to chose a purpose within a "classical" classification of hypermedia provided by (Brusilovsky 96): informative, educational, promotional, commercial, or work-oriented. The application general purpose can be different for the various categories of users, or there might be different purposes for the same user category. For example, for "museum visitors with generic art interest", the application purpose might be both informative, to provide general information about the museum, and educational (to have users learn something about the museum domain).

At level 2, the above issue is addressed more precisely, again from the client perspective. Question Q2 tries to identify which direct and indirect effects should the application have on users (of the various categories/groups). For an informative application, for example, the client direct goal could be to inform users about the museum content and activities; the indirect goal could be to stimulate them to actually go and visit the museum, so to increase the number of visitors.

At levels 3 and 4 similar issues are addressed from the user perspective. Question Q3 aims at defining the general goals that can be ascribed to the different categories/groups of users. Examples can be "planning a visit", "discovering what the museum is about", "playing with multimedia contents", "being oriented in the museum", "learning more about a topic", "getting technical information about some subject", and similar. Answers should be compared with the answers at level 1, and should be consistent with them.

At level 4, the requirements obtained at the previous level are defined more precisely, from a more operational point of view. Question Q4 aims at identifying the specific tasks that users (of each category/group) should perform with the system to achieve their goals. Examples are: "discovering which are the present temporary exhibitions", "being informed of the museum time schedule and events", "exploring in detail the data about painting X", "discovering where an artwork is exhibited", "search for all the museum acquisitions after year Y", and similar.

Information schema slot	*Questions*	*Client*	*User*
level 1 application purpose - client perspective	*Q1.* What is the general purpose of the application (for each user category)?: educational, promotional, informative, research-oriented, work-oriented, commercial....?	☺	
level 2 application specific purpose - client perspective	*Q2.* Which effects is this application intended to bring to its users?	☺	
level 3 application purpose - user perspective	Q3. What are the user motivations for using the application (for each user category)?	☺	☺
level 4 user specific tasks	Q4. Which specific tasks should users (in each category) perform with the system?	☺	☺

Table 3. Why

If we consider that a hypermedia application is mainly a channel to deliver information, client and user motivations are crucial to determine what the actual content of the application should be, and to focus the acquisition of the What requirements discussed in the next dimension. Why requirements may also put some consistency constraints on the situation of use, as defined in the Where and When dimensions. For example, an educational application is not expected to be used for a short time in a crowded museum entrance, but in a more appropriate temporal and spatial context.

It is important to notice that understanding all the above factors (combined with the information provided by the When and Where questions) is very important in the design phase. It helps to determine, for each user category/group, a number of aspects: how to structure and to present the information content; which paradigms of information access must be provided (e.g., free navigation, guided-tour navigation, query-based access, history ...); which is the appropriate level of interaction with active media; which additional functionality must be included in the application (e.g., print, save-content, etc.). In principle, on the same semantic domain different "versions" of the application, or different views of the content structure, or different functionality, or even a different visual interface should be provided, to better address specific user and client goals.

The *What* dimension collects the requirements related to the actual content of the application and the characteristics of the available knowledge sources. This information is fundamental to design the information structures of the application.

The questions at level 1 concerns the definition of the general subject of the application, both in general terms (e.g., art, science, history, anthropology, ...), see question Q1.1, and in more specific terms, if necessary (i.e., Italian Renaissance art), see question Q1.2.

Level 2 identifies the various types of information which should be included in the application (question Q2.1) and the relevant rela-

Information schema slot	*Questions*	*Client*	*User*
level 1 ***general domain***	Q1.1 What is the general theme of the application? Q1.2 What is (are) the specific subjects of the application?	☺	
level 2 ***knowledge sources***	Q2.1 What are the most important types and sub-types of information objects in the specific domain which can be available for the application? Q2.2 What are the relationships among these objects? Q2.3 Approximately, how many information objects are available or can be produced for each type? Q2.4 Under which media are the various objects currently and potentially available?	☺	
level 3 ***macro-content by user category/group***	Q3.1 Which preferences on the domain content can be ascribed to each user category/group (i.e., which are the most important types of information objects and relationships which are particularly relevant for each user category/group)? Q3.2 Approximately, how many objects of each type would it be necessary to include for each user category/group?	☺	☺
level 4 ***micro-content by user category/group***	Q4.1 For each user category/group, which specific content for each object type should be provided? Q4.2 Which media can be use to deliver such content?	☺	☺

Table 4. What

tionships among these elements (question Q2.2) These may include, for example, museum events, temporary exhibitions, art works (with possible sub-types as paintings, sculptures, furniture, etc.), author bios, art movements, and similar, and their mutual relationships. At this level, the various types of objects are also characterized in terms of their quantity (question Q2.3), the media on which they are currently available (e.g., text only, or text + image, or video + text, etc.) or can be produced (question Q2.4).

At level 3, questions similar to Q2.1 and Q2.3 are addressed for each category/group of users.

At level 4, information types are analyzed in-the-small, at a finer level of granulary. Questions Q4.1 and Q4.2 try to identify, for each information type, the specific content and media that is of interest for each user category/group. For a "painting" object, for example, an art researcher may be interested in a number of details (e.g., date of acquisition by the museum, the X-ray analysis) which may have no interest for the casual visitor. The latter might be more attracted, for instance, by an animation of the painting elements.

The *When* dimension describes the situation of use in its temporal characteristics. The first question Q1 considers the operational context in which users of each category/group use application. For an educational application, for example, "teachers" may use it during a lecture, and "students" use it when doing their homework. These aspects should be defined consistently with the application purposes and motivations of use, as defined in the Why dimension.

The second question tries to quantify the sessions of use, identifying the frequency of use (Q2.1) and the session duration (Q2.2). The temporal usage aspects should be oriented to fit the user requirements defined by other W dimensions as Who and Why, or at least to be consistent with them. For example, we expect that an informative application for casual visitors is used once and for a very short time, while a work-oriented application for specialists involves long and frequent sessions of use.

When-factors are also strictly connected to physical usage characteristics as defined in the Where dimension (see next paragraph). For example, it could be questionable to require a long-usage application for a place, like a crowded museum entrance, where it should be instead used for very short sessions, while the same application is appropriate in a quiet place like a museum library. Temporal aspects are also crucial to better focus the content aspects (i.e., the What dimension). For example, if there is short sessions of use are expected, there is no utility to include in the application a huge, detailed amount of content which users will never have the time todiscover nor to explore.

From a design perspective, the temporal aspects, combined with the Why-factors, impact on the organization of information structures, and on the choice of the functionality that must be provided by the application. For short sessions, deeply nested information structures are quite inappropriate, for the same reason stated above: users will never have the time to explore them in all their depth, but would rather prefer simple, "flat" structures. If users have a precise information tasks to perform, in a short time, a query mechanism for direct search must necessarily complement pure navigation, but if users have explorative tasks ("I need somehow related to this topic, perhaps also to this other one ...") free navigation and deeply interrelated structures are what the user expects.

Information schema slot	*Questions*	*Client*	*User*
level 1 ***operational context***	Q1. For each user category/group, during which activity are users expected to use the application?	☺	☺
level 2 ***session frequency and duration***	Q2.1 How many sessions of use are approximately supposed (for each user category/group and for each activity)? (one, a small number, many, very many, on a day-base, weekly base, monthly base,...) Q2.2 What is the supposed average duration of a session?	☺	☺

Table 5. When

Information schema slot	*Questions*	*Client*	*User*
level 1 ***physical context of use***	Q1. In which environment will the application be located?	☺	
level 2 ***context characteristics***	Q2.1 Where will the application be located specifically? Q2.2 Which are the physical characteristics of the situations of usage (e.g., level of noise, crowd, ...)	☺	

Table 6. Where

The *Where* dimension describes the physical situation of use under its spatial characteristics.

The first question Q1 concerns the general environment in which the application is located (e.g., in the museum, at home, at school, in a tourism office, ...).

At level 2 the location is defined more precisely. Question Q2.1 concerns the specific place where the application is installed, e.g., the museum entrance, the library, the reading room, the exhibition rooms, the museum store, etc. Question Q2.2 defines the characteristics of this place that may impact on how the system can be used. Indeed, the situation of use is very different in a noisy and crowded entrance than in a silent library. As already mentioned, indications about the physical situation of use should be coherent with the previous requirements, specifically the When and Why; as such, they may induce a revision of some of the previous results.

4. W5+ in use

The W5+ framework rationalizes our experience achieved in many hypermedia projects carried on in the last five years in the museum domain. We also performed a number of experiments to test our method, using the W5+ questionnaire schema to interview the curators of 10 private and public museums in Milan for approximately two hours and order to identify their user requirements. The museums involved in the experiment, and their related subjects, are the following:

- Museo Bagatti Valsecchi – art
- Museo del Duomo – art and history (of the Duomo di Milano)
- Museo del Giocattolo – toy
- Museo della Scienza e della Tecnica - science and technique
- Museo di Storia Naturale – natural history
- Museo Minguzzi – art (sculpture)
- Museo Teatrale alla Scala – history of theatre (La Scala)
- Pinacaoteca Ambrosiana – painting
- Pinacoteca di Brera – painting
- Raccolta Bertelli – prints and drawings

The above museums are different both for their mission, their content, and their dimension. Some of them have already done experiments or products in the hypermedia area, including CD-ROMs and Web sites. Still, a number of user requirements we collected during the interviews were homogeneous, as we will discuss in this section.

In the following tables, we aggregate the user requirements of each museum along the various dimensions. For privacy reasons, each museum is represented by a code, and content requirements are discussed in general terms to avoid identification.

Most museum indicate "visitors" as the general category of target users. Only one museum has explicitly indicated "specialists", i.e., researchers in the museum domain.

Some museums distinguish among "casual" visitors, who have a generic interest in the museum topics, and "highly motivated visitors", who are not professionals in the museum domain but are fond of it, or have some kind of special interest in its contents.

Museum	*User categories*	*User -groups*	*Sub-categories characteristcs*
M1	• visitors		domain knowledge: low-average low computer experience
M2	• visitors	• casual visitors • highly motivated visitors	visitors: domain knowledge: low-average highly motivated visitors: average-high domain knowledge BOTH: low computer experience
M3	• visitors	adults, kids	adults: low computer experience kids (age 4-15): low-average computer experience
M4	• visitors	• casual visitors: adults, kids • highly motivated visitor	casual visitors: domain knowledge: low-average adults: low computer experience kids (age 4-15): low-average computer experience highly motivated visitors: average-high domain knowledge, low computer experience
M5	• visitors	adults, kids	adults: domain knowledge: low-average low computer experience kids (age 4-16): low-average computer experience
M6	• visitors	• casual visitors • highly motivated visitors	• casual visitors: domain knowledge: low-average • highly motivated visitors: domain knowledge: average-high Both: low computer experience
M7	• visitors		domain knowledge: low-average low computer experience
M8	• visitors • specialists	visitors: • casual visitors • highly motivated visitors	• casual visitors: domain knowledge: low-average • highly motivated visitors: domain knowledge: average-high • specialists domain knowledge: high Both: low- average computer experience
M9	• visitors		• visitors: domain knowledge: low-average computer experience: low
M10	• specialists		domain knowledge: high

Table 7. Who

What

All museums require limited information to present the museum and to provide an overview of its collection. With one exception, most museums are oriented to develop mono-thematic hypermedia, which focus on one specific subject among all the possible ones related to the museum content (mainly for reasons of development costs).

One museum has identified the interest of including also the presentation of a single room of the museum, with a description of all the exhibited works, and to put it on-line, to stimulate the curiosity and to motivate users to organize a real visit to the whole museum.

Another museum has raised the interesting idea of including "back-stage" information for non-museologists, describing how the exhibition are conceived and arranged, and the research work underlying the whole process.

Only one museum is interested to the development of a complete catalogue of the museum

Museum	Application purpose (client view)	Application specific purpose (client view)	Application Purpose (user view)	User Specific Tasks
M1	Informative, promotional	• promotion - advertise the events - attract visitors - offer a more modern look to the institution • information: - help people get to the museum - presenting few representative pieces mostly related to a single theme - provide an rapid overview of the museum content	• curiosity • be aware of museum activities • learning more about some topics	• have a look at the events; • take a short virtual tour about a given theme • have an overview of the museum content
M2	Informative, promotional	same as M1	same as M1	visitors: same as M1, but in addition: deeper and more exhaustive exploration of contents
M3	Informative, promotional	same as M1	• curiosity • learning more about some topics	same as M1
M4	Informative, promotional	same as M1	same as M1	visitors: same as M1 highly motivated visitors: same as above, but in addition: deeper and more exhaustive exploration of contents
M5	Informative, promotional, educational	same as M1; in addition: - to use new media (sound and animation) to present a subject under a different perspective - to stimulate young visitors to understand research methods in the museum domain	same as M1; in addition: learning by playing with multimedia contents	visitors: same as M1, but in addition: interaction with active media
M6	informative	same as M1 (for the informative aspects only)	• curiosity • learning more about some topics	same as M4
M7	Informative, promotional	same as M1	• curiosity • learning more about some topics	same as M1
M8	Informative, promotional	same as above in addition: to make available although in a electronic form, material which cannot be exhibited for space or deterioration reasons	for visitors: same as M1 for specialists: • to discover non publicly available material • to get technical info	same as M4
M9	informative	same as M1 (for the informative aspects only)	same as M1	same as M1
M10	work-oriented	to support study and research	study and research	searching for specialized information; interacting with images (looking for details)

Table 8. Why

pieces, including images and technical data about all works. This museum collects material which is highly fragile and subject to deterioration, and the electronic catalogue offers specialists the possibility of inspecting such material for study and research in a safe way.

All museums (but one) acknowledge the need of providing (on-line) information concerning opening hours, museum location, schedule of events.

In terms of media, most of the institutions are quite "conservative" and consider only text and image.

Three of them have indicated animation as a possible medium for some kinds of contents, and one (M5) is interested to sound. Animation is mainly viewed as a mean to show an object under different spatial perspectives. In the case of M5, animation + sound are required to reproduce the physical context of an object.

When

For all museums, the answers concerning temporal aspects are different for the various categories of users, but quite homogeneous within each category.

Visitors (including the highly motivated ones) are expected to use the application in three situations: just before starting a museum visit, at the end of a visit, or during free time planning. Only one museum envisioned the possibility, for visitors, to use the hypermedia during the visit, while looking at some exhibited work. This is the case of museum M5, which is interested interactive multimedia material to complement what is shown in the room, in order to reproduce the physical context of some " object".

In all other cases, museums are worried that the availability of a hypermedia system while visiting the exhibition rooms may distract the visitor attention from the "real" pieces.

The average duration of visitors usage sessions is very short (5-10 minutes), but for highly motivated visitors, museums expect that they will use the system for longer sessions (20-40 minutes) at the end of a visit.

The expected frequency is low – 1 session for casual visitors, and 1-3 sessions for highly motivated visitors.

For specialists - see M10 - the museum expects that these users will be interested to use the application before, during, after the visit, and even outside the museum, during their study and research. Sessions of use run frequently and their duration ranges between 10-30 minutes during or before the visit, and is much longer in the other situations (1-2 hours).

The physical situations of use in the various museums is quite coherent with the requirements defined in the previous sections. Still, it is a bit surprising that museum M9 does not envision any use of the application outside the museum, although it conceives a promotional purpose for it (see Why table). All museums that envision an application use outside the museum, plan to put it on-line, but regard the on-line use as limited to "organizational" information, mainly for copyright reasons. Five museums consider CD-ROM as the main channel to deliver domain specific content.

Museum	*Physical context*
Bag	• entrance/exit • home
Duomo	• entrance/exit • reading room • home
Toy	• entrance/exit • home
Scienza	• entrance/exit • home • reading room
St.Nat	• entrance/exit • home • exhibition rooms
Ming.	• entrance/exit
Scala	• entrance/exit • home
Ambro	• entrance/exit • home • reading room
Brera	• entrance/exit
Bert	• reading room • library • personal research environment

Table 9. Where

5. Conclusions and Future Work

Understanding user requirements is crucial to design usable and useful hypermedia applications. Thus, collecting and analysing user requirements is a fundamental activity in the overall development process. W5+ provides the cognitive tools to support this activity, focusing on a specific class of applications for museum hypermedia, and offers to the museum community a common vocabulary by which compare different user requirements and share experience and results.

Not only W5+ helps application analysts to gather and to analyze user requirements in a structured, organized, cost effective way; it also helps to standardize them. Especially if requirements acquisition is performed by different persons, standardization of the interview method makes easier to compare the results, to share them among different analysts, to get to a more consistent and stable requirements base. It also makes easier the communication between analysts and designers.

W5+ is part of a wider methodology we are developing at Politecnico di Milano to support the pre-implementation process of hypermedia, from requirements acquisition to application design. This approach identifies three stages in this process, each one supported by a different model: the *W5+ model*, for requirements acquisition and analysis, the *HDM model* (Garzotto 93, Garzotto 95), for application design, and the *SCINDLer model*, to support translation of requirements into design choices. Since the latter process is cognitively complex, the main goal of SCINDLer is to introduce intermediate concepts to help designers fill the gap between requirements and design. SCINDLer concepts are based on the idea of hypermedia mode (Garzotto 97) and design patterns (Discenza 99, Garzotto 99). SCINDLer is still in a preliminary definition phase, and is the subject of our ongoing research.

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