THE 2QCV3Q QUALITY MODEL FOR THE ANALYSIS
OF WEB SITE REQUIREMENTS

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Requirements analysis constitutes a critical phase in the development of software systems, and for Web sites it can often be a determining factor in the success of the company or organisation. A thorough requirements elicitation will take into considerations the objectives and needs of all the actors involved. It is therefore important for an analyst to have conceptual instruments that support their identification, taking into account the different components of a Web site. In this paper we propose the application of a quality model - the 2QCV3Q meta-model - to the activities related to the requirements engineering process. To illustrate this we describe the requirements analysis for an ONLUS organisation called "No Pain for Children", a nonprofit association for promotion of analgesic treatment. Developed to evaluate the quality of existing Web sites, the meta-model proved to be a useful tool also in gathering and negotiating the requirements. In particular, it was possible to highlight from its conception the priorities of the newly founded association and also the potential areas of conflict between the objectives of the association (and its promoters) and the needs of the doctors and families involved with it.

1. Introduction

Requirements analysis has for some time been recognised as a critical phase in software development (see for example [27] or [28]), but for Web sites some of these challenges are particularly salient (similar considerations apply for Web applications [5], but for the sake of simplicity, in this paper we will use only the denomination Web site). Several studies exist regarding the differences between Web sites and more conventional software systems (among the most recent, see [30]); in fact, the field of Web Engineering has emerged precisely to deal with the unique difficulties posed by Web site development [7]. These differences can be traced to four fundamental facts:

Strategic role of Web sites Given the high level of competition existing on the Web, simply being present on-line does not guarantee that a site's sponsors will reach their objectives for and through the site. Not only, but often the creation of the Web site coincides with the birth of the company whose business model does not foresee a physical location nor an articulated organisational structure (consider for example, virtual banks); the association considered in this paper falls into this category.

Market and technological evolution/changes The pressures of time and continuous changes in the market and technological environment call for innovative solutions to maintain competitiveness, thereby imposing ever tighter demands on time and resources. Web site requirements are particularly fast changing, so much that the development of Web sites now calls

for the adoption of an iterative incremental requirements process based on the development of prototypes [12].

Presence of several diverse components in a Web site They require both a multidimensional, systemic approach and a multidisciplinary development team. These two aspects are closely related: Web sites contain elements that go beyond the traditional components of software systems. This means that a successful site will be the fruit not only of ICT experts, but also of experts in business, marketing, creative design, and representatives from the field or domain itself (professionals from the tourism field, for example, for the site of a tourist organization).

Variety of stakeholders The design and use of a Web site involves a wide spectrum of actors or "stakeholders" both internal and external to the company (for a discussion on "stakeholder concerns" see [25]). Web sites have a potentially wider and more differentiated target consumer base. Their users can play different roles (employee, client, consumer, company – as in B2B applications – etc, developer); they can also have very different profiles, characterised by different languages, cultures, education, computer proficiency, etc.

As regards requirements analysis, all of these elements serve to increase the relevance of the organisational and cultural aspects, above all the importance of communication among stakeholders. A key challenge then, lies in finding a common language that promotes effective communication both within the development team as well as with or among the different groups of stakeholders. Given that a Web analyst must take into consideration the objectives and needs of all parties involved, it is important for him or her to have conceptual instruments that make it possible to effectively elicit, negotiate, document/model and validate the requirements according to a multi-view approach. In this paper we argue that all of these activities could benefit from using a quality meta-model such as 2QCV3Q, which supports them in referring to the different elements of a Web site. Based on classical rhetorical principles, the 2QCV3Q meta-model (recently renamed 7Loci) was developed to evaluate the quality of existing Web sites and has been applied over more than six years in a number of evaluation projects [16, 19, 17]. The model proved to be useful, however, also as a framework to support requirements analysis. To illustrate this point, in this paper we present its application to the requirements gathering and documentation for an ONLUS organisation called "No Pain for Children", a nonprofit association for promotion of analgesic treatments for pain.

Section two illustrates the main assumption of the paper – the possibility to use a Web site quality model as a conceptual framework to support requirements analysis for Web sites - and describes the essential aspects of the 2QCV3Q meta-model. Section 3 describes the purpose of the "No Pain for Children" association and the requirements analysis completed using the 2QCV3Q meta-model. The following section is dedicated to the related works, and places our approach in the general context of methods and models for Web site development, underlining the points of contact and possible points for integration with existing models. The concluding section summarises the findings that emerged and which are relevant for the requirements analysis of the Web sites, as well as for future development of the meta-model.

2. The 2QCV3Q quality meta-model for requirements analysis

2.1 *Web site quality evaluation models to support stakeholder communication*

In this paper we propose the use of a Web site quality evaluation model as a tool to use from the beginning to support requirements analysis of a Web site. According to the ISO, quality is "the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs" [10]. In substance, this definition stipulates that an evaluation of quality of a Web site must verify whether the site satifies the "requirements" of the diverse stakeholders or "actors". A natural outcome of this goal, therefore, is to add to the current use of a model to evaluate Web site quality by also using it to support requirements analysis. In light of the previously discussed aspects characterizing Web site development, the principal objective is to arrive at a conceptual framework that makes it possible to:

- Install a "comunication platform" among the actors, that is, among the people making up the development team, and with the customers/clients and users. This would serve to provide a common "glossary" and a framework to classify requirements initially given in natural language. Moreover, requirements modelling through conceptual models such as use cases or scenarios would no longer be necessary in situations where this is premature, for example, when further information is necessary in order to complete the business or domain model.

- Involve the actors in all phases of the requirements engineering process: elicitation, analysis and negotiation, documentation, validation [27], thereby favouring an "interactive" as well as iterative approach (figure 1). This results in a tool that supports a "lightweight" approach to activities connected with requirements analysis.

In the language of agile methodologies (see for example [31]), the quality model becomes the basis for a *metaphor* for the Web site being developed; the model amd the resulting metaphor provide a simpler and more easily understood way of presenting the site to all stakeholders involved in the project, especially since everyone is using the same vocabulary. The use of metaphor also favours creativity, a vital element in Web site requirements analysis.
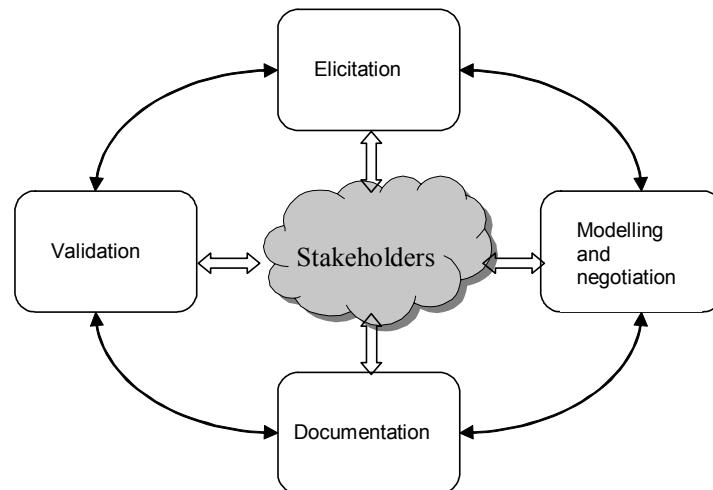

Figure 1. Activities of the Web site requirements engineering process

Regarding the stakeholders, or actors, there are three principal types of *role* which are involved in the creation and development of a site: the *owner* of the site, the *user*, and the *developer* (figure 2). Each of these have different expectations of the site and attribute different degrees of importance to different elements:

- the owner/s of the Web site look principally at the objectives to be reached by means of the site and can be referred also as sponsor/s, promoter/s or client/s (with respect to the team who develop the site); in reality several actors can occupy this role, as occurs, for example, in the case of sites commissioned by a consortium; therefore, the owner/s of the site can be defined in general as the body or bodies that are paying for the project development;

- the users focus on their individual needs and expectations; it is worth noting again the important, fact that for a Web site a particularly critical step is the identification of users, especially where this is determinant for the business model or strategic choices of the owner/s of the site; indeed, for some projects it is necessary to construct profiles of different categories of users so as to better personalise information and services provided [29];

- technical as well as non-technical developers take part in the site's development; this means that alongside ICT experts with a wide range of competencies – software, database, networking, etc. – there are experts from the application domain to which the Web site is being applied, and from the business realm. Added to this group is the creative designer, a key figure in Web site development, given the importance of graphic presentation of the site.
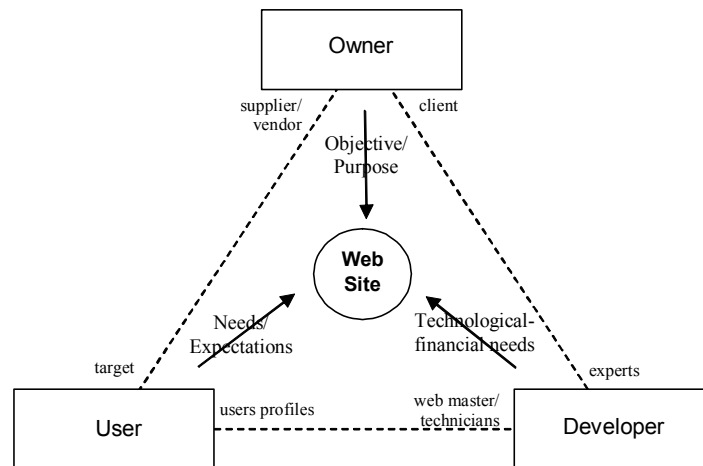

Figure 2. The needs of actors involved in developing a Web site

2.2 *The 2QCV3Q quality evaluation meta-model*

Several models and frameworks for evaluating the quality of Web sites currently exist (a workable classification is given in the Related works section in [19]; an extensive bibliography is also available at http://www.economia.unitn.it/etourism/wqresources.asp). In studying the possibility of applying a quality model for requirements analysis in Web site development, we will refer to an original meta-model, called 2QCV3Q. The initial assumption used when defining the model is that a Web site is a hypermedia system in which the communicative role and the pragmatic valency are essential. The model thus refers to some principles of classical rhetoric used to determine the completeness of a given exposition. In particular, our theoretical reference scheme uses the seven *loci* or *argumenta* introduced

by Cicero in "De Inventione" and redefined in medieval treatises (*locus* in Rhetoric means "basis of an argument" and *argumentum* in Latin means "argument, proof, sign") [3, 8]. Since the 1940s, a simplified set of these loci has been widely used in journalism, taking the form of the "five wh-questions": who, what, why, when, where, or of the "5W+H" formula, considering also "how" (coordinates which turn an expression into a communicative act); the five loci also form the basis of one of the first models of the modern theory of communication proposed by Lasswell in 1948 [11]. By applying the 2QCV3Q model at a first level of application, the evaluation and design of a site can be viewed as a series of replies to the questions set by the Ciceronian loci (figure 3). The interpretation of the loci derives from both the analysis of existing models and the experiences that have come forth from completed projects, and also from some methodological considerations (aiming, for example, to have a similar or equal number of attributes for each dimension, and following the rule of 7+/- 2 in [20]). This results in seven fundamental dimensions of a Web site (if considered in the following order: *quis quid ubi quibus auxiliis cur. quomodo quando*, it tends toward a hexameter, used by rhetorics such as *chria*, which is used to amplify and exagerate when forming a sentence.)

QVIS? (Who)	->	**Identity**
QVID? (What)	->	**Content**
CVR? (Why)	->	**Services**
VBI? (Where)	->	**Location**
QVANDO? (When)	->	**Maintenance**
QVOMODO? (How)	->	**Usability**
QVIBVS AVXILIIS? (With what means and devices)	->	**Feasibility**

Figure 3. Ciceronian loci and dimensions of the 2QCV3Q or 7Loci model (in Latin *V* stands for *U*)

In the six years since the development of 2QCV3Q, we have applied the model to sites of various kinds and in distinct domains, in such diverse sectors as tourism, education, service, and business in general. Moreover, the objectives of the various quality assessments performed were different. The results of these applications highlight the flexibility of the model, which proved useful as a framework for the analysis and evaluation of Web sites independently of their goals and domain. In short, we can say that this model is domain-independent, general-purpose and that it allows for a multi-stakeholder approach.

We now provide a brief description of each dimension of the model, specifying how that dimension is useful in requirements analysis.

I. **Identity (Quis?)** This regards the image that the organisation projects or desires to project and therefore all elements that come together in defining the identity of the owner of the site. For example, the brand of the company, a catchy logo, and, in general a graphic layout that is in line with the overall aim of the organisation. If the site is targeted at varying categories of users, the ability to adapt the images to different users is also important.

II. **Content (Quid?)** This dimension refers to the information available for users on the site, and how this information fulfils the owners' and the users' goals. Also important to consider is the quality of the information provided, measured in terms of its timeliness, reliability, precision, and other similar features.

III. **Services (Cur?)** Services must be provided on the site that satisfy the needs of users and at the same time work toward the owners' ultimate objectives for the site. A certain level of quality must be guaranteed, therefore, for such services, particularly for those sites where secure payment on-line and other privacy or ethical issues are relevant.

IV. **Location (Ubi?)** This dimension regards the visibility of a site, that is, everything that contributes to making the site easy to find: an easily remembered address and the use of strategies that make

the site easy to find through search engines. This dimension also refers to the ability of the site to offer a space where users can communicate with each other and with the organisation.

V. **Maintenance (Quando?)** This comprises all activities that guarantee proper functioning and operability of the site, and therefore any links contained therein, in addition to updating the technology and adapting the site to new requirements. Often overlooked, this dimension—as with many applications based on information technologies—while adding to final costs, is nonetheless vital for the ultimate success of the project.

VI. **Usability (Quomodo?)** The most thoroughly studied dimension (see for example [21]), it determines how efficiently and effectively the site's content and services are made available to the user. To do this, the target of the site must be considered as a variable factor; the user's familiarity with computers and Web navigation, the hardware and software used, the modality used to access the site, as well as the user's language skills must all be taken into account.

VII. **Feasibility (Quibus auxiliis?)** This includes all aspects related to project management: time and budget constraints (also including gathering of data on traffic at the site for eventual cost-benefit evaluations or the calculation of ROI – Return on Investment), skill requirements, architectural choices - e.g., commercial or public domain (open source), the identification of development tools and standards to adopt for site implementation, and the integration with existing technological platforms.

Each dimension of the model can be specialized by introducing attributes and subattributes to the desired level of detail. When compared with existing quality models, the 2QCV3Q or 7Loci can be seen as a meta-model for classification of diverse elements, insomuch as it allows for a scalable evaluation at varying degrees of detail [18]. Relying on experience gained in Web site quality evaluation projects, we have defined a model which is still largely domain-independent and that provides a reference scheme to label and classify the principal aspects for requirements identification for the diverse components of a Web site (see table 1).

2.3 Web site requirements analysis using the 2QCV3Q model

In the table obtained by specializing the seven dimensions of the model 2QCV3Q, the loci become the root nodes used to build "requirements trees" [22]. It should also be noted that these dimensions are interrelated and can affect each other both positively and negatively. From a communicative perspective, this "forces" the experts involved in the site design project to consider also those aspects that are not in their field of expertise but which could have an impact on the end product. For example, graphic artists should not plan nor attempt to introduce features that add unwarranted download time or which inadequately reflect the image of the company or entity; similarly, the model serves to remind the ICT experts that to achieve set goals or marketing targets it is necessary to plan a site that can be visited without having to install the most recent version of the browser or to download a plug-in; in short, the site must be designed according to a systemic approach.

Table 1. The 2QCV3Q model

CICERONIAN LOCI	ATTRIBUTES AND SUBATTRIBUTES
QVIS (*Persona:* Who?) **IDENTITY**	*Identification* − Brand or Charisma, Image − Target users' profiles *Characterisation* − Design − Personalization
QVID (*Factum:* What?) **CONTENT**	*Coverage* − Domain referred to owner's and users' goals − Value of information and links *Accuracy* − Quality of information − Source(s), author(s)
CVR (*Causa:* Why?) **SERVICES**	*Functionalities* − Functions needed by owner and users − Adequacy to owner's and users' goals *Control* − Correctness − Security, ethics and privacy
VBI (*Locus:* Where?) **LOCATION**	*Reachability* − Intuitive URL − Retrieval *Interactivity* − Contact information − Community building
QVANDO (*Quando:* When?) **MAINTENANCE**	*Corrective maintenance* − Check-up, links, dates − User assistance *Adaptive Maintenance* − Enhancement − Reengineering
QVOMODO (*Modus:* How?) **USABILITY**	*Accessibility* − Hardware and Software requirements − People with disabilities *Navigability* − Structure, Orientation − Download times *Understandability* − Languages − Level of terminology
QVIBUS AVXILIIS (*Facultas:* With what means and devices?) **FEASIBILITY**	*Resources* − Financial and Human Resources − Time *Information and Communication Technology* − Hardware (computer, networks) − Software (implementation, integration)

For requirements analysis the dimensions of the 2QCV3Q model can also be linked to the relationships among actors described above (see figure 4).
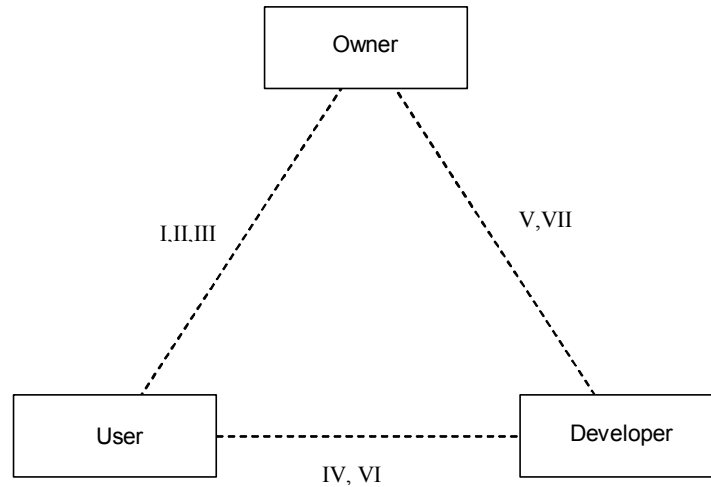
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                    ┌──────────────┐
                    │    Owner     │
                    └──────────────┘
                   ╱                 ╲
          I.II.III                    V,VII
               ╱                         ╲
    ┌──────────────┐   IV, VI   ┌──────────────┐
    │     User     │- - - - - - │  Developer   │
    └──────────────┘           └──────────────┘
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Figure 4. Dimensions of the 2QCV3Q model and requirements of the actors

Traditional techniques to gather the requirements include: interviews, questionnaires, observation of the work environment, sampling of existing business documentation, meetings and brainstorming sessions, external research (for example, investigation of best practices, competitor analysis). We argue that the 2QCV3Q model offers useful guidelines to support all of these "fact-finding" techniques. In particular, it can be used to structure and conduct the interviews, to design questionnaires, to orient the reading of existing documents (forms, business reports, reviews), and to analyse the Web sites of competitors, to describe a few possibilities. A Web analyst can use the quality model dimensions starting from the first iteration of the requirements process to identify and classify the information gathered, which is usually given in natural language, for all the activities given in figure 1. It is more realistically possible to avoid losing information during the elicitation phase, to negotiate conflicting views and document requirements using a language commonly understood by all stakeholders, thereby involving them in a tangible way in requirements validation. The usefulness of conceptual models such as the Entity-Relationship diagrams or the Class diagrams as tools for communication with users or with owners is not fully supported by the real facts. The use of attributes and subattributes can be calibrated to adapt the quality model so that it gives effective support to the technique eventually adopted. For example, to conduct interviews with the "owner/s" in the study phase, it may well be sufficient to ask questions only related to the attributes, while for user interviews it might be more useful to refer also to the subattributes.

To illustrate these points, the next section describes the application of the 2QCV3Q model to the requirements analysis phase for the site of a nonprofit association whose business model is still being developed and whose stakeholders have diverse backgrounds, ICT expertise, objectives, and who approach the site without a uniform language.

3. The 2QCV3Q model for the requirements analysis of the Web site for "No Pain for Children"

3.1. The association "No Pain for Children"

The first step of the requirements analysis is to study the "mission" of the "owner/s". The association "No Pain for Children" was founded in Trento (Italy) in summer 2001 under the form of an

ONLUS (in Italian "Organizzazioni non lucrative di utilità sociale" which means Not-for-Profit Social Service Organisation) association. Their aim is to spread a "culture" of treatment for physical pain experienced by children. The therapy used to relieve pain is technically called "analgesic therapy", which includes not only pharmacological treatment (the administration of non-narcotic analgesics, narcotic analgesics and local anaesthetics), but also nonpharmacological treatments such as hypnosis, acupuncture, play, etc. From the first meeting with its main promoter, who had personal experience with the problems that children and parents face due to the lack such therapies, it emerged that the mission of the association is:

> "the drastic reduction of pain among ill children by means of the diffusion and adoption of therapies for pain relief and of palliative treatments".

The association's founder was motivated by the fact that knowledge of these therapies and their potential at a paediatric-neonatal level is not widespread in Italy, in particular among parents of these young patients. Similar situations exist to more or less the same degree in several other developed countries, although we have not done an in-depth search for studies in this area.

Since its inception, "No Pain for Children" has in accordance with its mission envisaged a series of activities and tools that vary depending on the group targeted; among these instruments is the Web site, used as a general sensitising and information providing tool for the public, specifically for parents with ill and suffering children and also for medical and paramedical professionals. To this end, one of the authors was involved within the organisation itself, thereby acting as both owner/promoter as well as developer.

The first phase of the project focused on the analysis of the problem [32] in order to better understand the environment the association is working in and to identify problems (and their causes) related to the application of palliative treatments to children.

Our study of the diffusion of palliative treatments for children confirmed that the founder's experience is not unique [4]. Furthermore, this research revealed that the limited adoption of these therapies is due principally to the lack of information available in the area, a fact demonstrated by the doctors' own lack of interest or their disbelief in the applicability and/or the effectiveness of such treatments. Often, to aggravate the situation, the high costs of many of these therapies discourage the administrations of health service providers (in Italy, the "Aziende Sanitarie Locali") from adopting them; in other cases, however, the non-use of these therapies stems from a reality where it is actually impossible to provide them. Among the most frequent cause is the lack of personnel (especially anaesthesiologists), the unavailability of space or other such logistical problems. Currently, the majority of clinics provide these services only in part, for certain typologies of illness (e.g., tumours) and/or they provide only certain types of analgesic therapies (e.g., pharmacological). Moreover, there are no guidelines at a national level referring to this type of therapy (see figure 5). For the initial analysis of the problem the 2QCV3Q model was applied, taking three of its dimensions into consideration: Content, Services and Feasibility. The critical points identified are as follows:

- For the dimension *Content*, the principal problem is the difficulty experienced by both families and doctors in obtaining updated information on the topic, besides the often insensitive reaction from some operators which makes information sharing and diffusion manifestly more challenging. In addition, such information can be considered "sensitive" under Italian law, or subject to bureaucratic screening; thus, a consideration of *Content* requires awareness of the legal and security issues involved, as well as the ethical aspects.

- As for the dimension *Services,* there are notable hurdles for parents attempting to secure palliative treatments for their children, often resulting in the so-called "journeys of hope" to those few centres that offer the treatment but which at the same time are unable to satisfy all incoming requests. The need for improvement and further diffusion of services of an informative and educational nature is evident, so as to eventually result in a more systematic application of such palliative treatments and assuring their quality

- For the dimension *Feasibility*, in addition to the previously mentioned cost of the therapy itself, the scarcity of financial and human resources has meant that similar problems of feasibility exist in sustaining the costs of training for medical personnel and support for the families. In Italy the Department of Peadiatrics in Padua offers a fuller range of therapies; for this reason the association has tried since the beginning to involve some doctors in the development of the site.
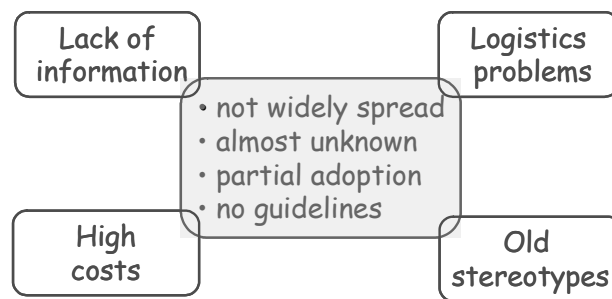

Figure 5. Problems in the application of the analgesic therapies for pain in children

The results coming from the analysis of the problem activities led to the definition of the aims of the association, in addition to the objectives for the site (see figure 2).

After considering the current degree of diffusion of these pain therapies, it was made plain that in order to undertake such an ambitious mission (the diffusion and adoption of these therapies on a vast scale) it would be necessary to establish a series of intermediate goals aimed at filling the gap in knowledge, skills, and verifiable practical applications in different target groups. The target users identified have been classified as follows:

- the parents with their children;
- the family paediatrician, generally representing the first and principal interlocutor between ill children and their parents;
- the personnel (doctors and nurses) of the clinics and hospitals;
- the personnel (doctors and nurses) of university paediatric clinics and of specialty wards.

Taking into account the target groups which the association seeks to reach, the objectives of the association can be described as follows:

- to provide information on the effective possibility of pain treatment;
- to educate, meaning to spread awareness and concrete knowledge of existing methods of analgesic therapy and palliative treatments for children;
- to promote scientific research, to contribute to the research on new therapies for treatment of pain;
- to provide concrete support for the adoption of these therapies, providing services for the development of new centres for analgesic treatment.

As for its geographic reach, the association aims to spread beyond Trentino Alto Adige, where its legal headquarters is located, to other Italian regions and abroad.

A key decision regarding the project plan was to foresee two "macro-phases" of activity to accomplish the mission of the association "No Pain for Children":

- the first phase is more culturally focused in that the aim is to bring to the fore the dire yet unrecognised need for pain relief treatments;
- the second phase (after successfully achieving the goals in the first phase) moves on to take steps to support and promote the creation of adequate services.

In other words, the association identified as a critical success factor the sensitising of different target groups to the problem of pain in children. Thus, the initial phase of the association is characterised principally by a series of activities designed to disseminate information on paediatric-neonatal analgesic therapy, its tools and capabilities, ultimately aiming to raise awareness among target groups (especially the parents) of the medical possibilities in this field. Such awareness should, therefore, be followed by a greater development and spread of a culture focused on relieving pain, thus empowering the patient to decide whether to tolerate a certain degree of pain during an illness. All of this will favour the demand for a higher quality of life, which in turn will stimulate the demand for further pain relief possibilities, a demand directed at the relevant institutes and professional groups. "No Pain for Children" offers, in this way, an interlocutor that strengthens the position of the patient and the parents, without taking the place held rightfully by medical caregivers. The association, in fact does not want to provide directly any type of medical consultation service: if doctors are willing and collaborative, they will use the association as a means to provide clear, correct, and reliable information to parents with ill children; this should help to inform parents of the different possibilities available to relieve the child patient's suffering; at the same time the parents become more capable of approaching the doctor from an informed viewpoint, able to analyse their own options with greater autonomy and freedom. "No Pain for Children" tries, therefore, through its information service, to promote a more constructive doctor-patient relationship by creating a more equal level of knowledge and awareness on both sides.

The association will play a pivotal role also in the second phase, through its assistance to different hospitals, thus favouring the development of new centres for paediatric-neonatal analgesic therapy in other parts of Italy. Activities will also include personnel training (doctors and paramedics) through bursaries, courses, conferences, and seminars offered by the association itself or in collaboration with other entities. At the same time funds gathered will be distributed to specific research centres for study of new pharmaceutical products and therapies.

3.2. *The requirements analysis for the Web site of "No Pain for Children"*

Requirements elicitation has four components that are carried out iteratively [27]: application domain, problem to be solved, "organisation" context, and stakeholders needs and constraints. The first three have been introduced in the preceding section and will be discussed further in this section, where we will focus on the fourth. The activities realized as part of requirements analysis took place over a period of approximately six months and were characterized by intense negotiations among the association members and development team. These discussions confirmed the importance of using a tool such as the 2QCV3Q model to create a common platform for communication.

To properly identify the requirements of a site it is necessary to consider the points of view of the three key actors: the owner/s of the site, the users, and the developers (see figure 2). To summarize briefly and expand on information presented here thus far, the Web site project for the association "No Pain for Children" involved diverse stakeholders, who are described below, mentioning also their degree of familiarity with the medical issues involved as well as their ICT expertise:

- owners:
  - the promoter (and president) of the association, who had personal experience as the father of a child that was subjected to extremely painful exams and treatments; this meant that the promoter also filled the role of user and it followed naturally that his vision would have a profound influence on the development of the project. He had no specific knowledge of palliative treatments (the domain of the application) nor great ICT skills.
  - the founding members: come from varying professional backgrounds and are generally highly skilled with the PC and Internet, yet none are familiar with the language of conceptual modelling. Their involvement in the planning and design of the site was marginal.
- users:
  - parents and their children: the parents play a vital role in sensitising the public and spreading awareness of the need for this type of therapy; it is fair to assume that they share for the most part a common familiarity with the medical issues – a knowledge derived from personal experiences with palliative treatments. They generally have an intermediate level of computer proficiency and use of Internet.
  - the doctors and other health caregivers: only some use Internet regularly; from the beginning diverse positions were expressed regarding palliative treatments; they use highly specialised medical terminology.
  - potential sources of financing for the association: a very diverse group, it is necessary to assume an intermediate command of ICT skills as well as some familiarity with the medical issues; however, given that a "culture" for the treatment of pain is not widespread, we cannot assume awareness of any specialised terminology.
  - random surfers in Internet: largely the same considerations apply as for the previous group.
  - the promoter and the founding committee, who refer to the site as a source of information when promoting the association and describing activities sponsored by it.
- developers:
  - a marketing expert, who also belonged to the founding committee and therefore is sensitive to the needs of the association and aware of its activities; this person is an expert in quality and was involved in defining the quality model used for the project.
  - a Web analyst, expert in requirements engineering and Web site quality evaluation; coordinated the project; no knowledge of the domain of the application.
  - a junior Web site analyst, who carried out most activities related to gathering requirements information, referring to the 2QCV3Q model and implementing the prototype versions of the site.
  - some doctors of the Department of Paediatrics in Padua as domain experts, with whom it was possible establish a collaborative relationship; they had an intermediate level of ICT skills and Internet use.
  - a professional graphic designer, who created the logo of the association and designed three different layouts for the pages of the site; in-depth knowledge and skill with ICT

and Web page design, however completely unfamiliar with modelling.

-     a translator, who produced the English language version of the site.

We can see that the composition of the project's development team reflects that suggested in [14]. Moreover, it is worth noting that the identification of the target group/s of the site constitutes an output of activities during requirements elicitation. This identification derives from the mission and from the specific objectives of the association described in the preceding section. In particular, doctors and nurses were identified as user categories, considering the current reality in this branch of medicine, and especially the gap that exists between available scientific knowledge and its practical real-life application. In the end, only the birth and growth of a specific and consistent demand for pain relief for ill children will stimulate the further interest of other health caregivers (doctors, nurses, medical students, etc.) who may still remain uncertain or sceptical. To this end, the role of the Web site is to encourage greater sensitivity to the issue of pain in children and to raise awareness among both of these target users (parents and medical/paramedical professionals) of the existence of diverse therapies and their potential.

Other objectives of the site emerged during the course of interviews with doctors from the Department of Paediatrics of Padua. From the outset these interviews were guided by 2QCV3Q quality model. Particular attention was given to the first three dimensions: *Identity*, *Content* and *Services*. It was clear from the beginning that the association did not want to have a "window" site aimed at simply promoting the association but rather a site in the healthcare field (thus calling for a graphic representation that would have both a serious and professional appeal while at the same time being comforting and reassuring to parents and children), whose main task would be to disseminate knowledge of health and medicine based on paediatric-neonatal analgesic therapy. It would also aim to inform professionals of the possibility of specialisation and educational opportunities (courses, conventions, seminars, etc.) available on- or off-line; the site itself does not provide any direct training services.

Besides defining the nature of the site, its objectives, and the categories of potential users, the meeting with the promoter and the medical staff involved in the project resulted in the definition of other requirements, all of which are fundamental in the definition of the requirements for the doctors and other health caretakers. They can be summarised as follows:

- the site must not give any indication that could lead a user to believe that it provides a medical consulting service; it is particularly important that parents not have these expectations of the site (due to resource constraints and for ethical reasons);
- the site should not excessively stimulate users to seek a direct doctor-patient relationship via Web;
- the site itself must not favour or promote any specific centre of paediatric-neonatal analgesic therapy, but rather should favour collaboration with other centres offering the therapy (even partial therapy), thereby creating a kind of network.

To gather information on the needs of the parents and their children, we used the 2QCV3Q model to define an interview guide, as a checklist of specific questions. We focused on four families in Trentino Alto Adige with children suffering from cancer; we tried to understand the needs of families living with such extreme health issues, characterised by the presence of various types of pain (stemming from the disease itself, resulting from the hospitalisation experience, from therapies and other procedures). After asking the parents to tell their stories and to share any personal experiences with this type of pain therapy, the interviewer proceeded to ask the questions based on the 2QCV3Q

model: the purpose of these questions was to understand which of the dimensions and related attributes and subattributes of the model were of greatest importance for this type of user.

We also decided to pose a series of questions to other doctors, all of whom worked in the Trentino Alto Adige region. This not only allowed us to validate and integrate the requirements already gathered for this group of target users, but also provided us with further information on the needs and behaviour of parents, given that the doctors have daily contact with them. Interviews with doctors were also predefined on the basis of the 2QCV3Q model and the questions provided a guide that proved important in obtaining useful information for the development of an effective Web site. After the doctors briefly recounted their professional experience and their experience with paediatric-neonatal analgesic therapies, we tried to understand the nature of their interest in this type of therapy and in having further information on the topic, in addition to their perception of the Web site of an association aimed ultimately at reducing the pain experienced by children with certain illnesses.

From the point of view of both the doctors and parents, access to clear, understandable, and reliable information (especially if not available from other sources) emerged as a fundamental and unavoidable need for the site. They also need to have information regarding the person or entity disseminating information and on the author. In essence they expect useful services, and to be able to interact in diverse ways with the association and its collaborators, and also to participate in its activities. Therefore, to offer a calendar of activities and to provide telephone, fax, and e-mail contacts are irremisible functions of a nonprofit association. Ease in locating and navigating the site also emerged as a key requirement: doctors have little free time; parents are already stressed by the search for solutions and may not be comfortable with this search medium. Even though the aesthetic appearance of the Web site was of little importance for users, they nonetheless expressed a desire for a generally attractive site that was able to transmit to the user a sense of comfort and support. Worth noting, is that all of the parents expressed a desire to contact others who were going through the same experience, wanting to compare stories and support each other. Doctors, on the other hand, appeared fearful of the uncontrollable effects that an on-line (or telephone) consulting service could have. Nevertheless, they were aware of the need to have a service (through a Web site) that is more accessible to people who do not work in the medical field.

The 2QCV3Q model was used also to analyse requirements of some "competing" sites. By "competing sites" we mean those nonprofit sites that try to sensitise the public on certain health issues and that attempt to offer information and services which are useful not only to medical and paramedical practitioners in this field, but principally to persons who are directly or indirectly involved in combatting specific illnesses. Using search engines (Virgilio, Yahoo!, Google) we found very few nonprofit sites dedicated exclusively to the topic of "paediatric-neonatal pain" (a list of all sites consulted is available at http://www.economia.unitn.it/etourism/risorseCollegatiTrattamento.asp). This also spurred us to take into consideration Web sites dedicated to other types of pathology and in the end we analysed the following sites:

- ANTEA (http://www.anteahospice.org): an Italian ONLUS association operating at a regional level (Lazio), but planning to expand on a national scale; it tries to disseminate the culture of palliative treatments and the assistance to terminal patients.

- AIMaC (*Associazione Italiana Malati di Cancro, parenti e amici* – Italian Association for Cancer Victims, parents and friends: http://www.aimac.it): a widespread and nationaly recognised association that fights cancer and works to find ways to cope and live with the disease.

- The Alzheimer Association (http://www.alz.org): an American association that works to find a cure for Alzheimer's disease, offering support to afflicted, their families and friends, and giving information to researchers and medical professionals.

- TACHD (The Association for Children with Heart Disorders: http://www.tachd.org.uk): an English institution led by families and friends of children with heart disorders, providing support to parents.

The decision to engage these four sites was made because, despite the different illnesses and target groups involved, all four sites have the same ultimate objective: to improve the quality of life of the afflicted person. With this goal in mind, all four associations use their Web site in an attempt to sensitise the public to the specific illness, but the principal function of the sites remains that of informing and supporting the ill, their families and friends. The analysis of these sites by means of the 2QCV3Q model is described in greater detail in [4]; this analysis made it possible to identify guidelines and best practices for the dimensions of the model. To cite some examples: among services offered, informational brochures and videos were considered useful; among interactive means proposed (direct and indirect) forums were considered useful, but also simple guest books where a user desiring contact with others can leave an e-mail address.

Of interest also were the fund-raising activities, so it was necessary to gather the Web site requirements for the target user group made up of potential financial sponsors of the association. The first dimension was deemed the most important, meaning that the site must prove to all stakeholders that it represents a viable association that promotes worthwhile intiatives. In addition to transmitting an appropriate image, fund-raising takes place through information dissemination and services such as announcing upcoming events, activities of selling merchandise on-line, etc. Equally important was information given on initiatives organized with association funds.

On a methodological level, the quality model was used to provide guidelines for all activities of reguirements gathering (see figure 6).
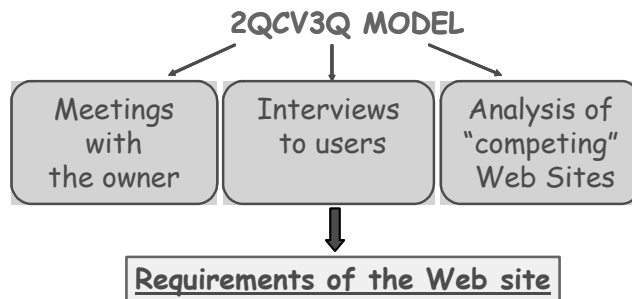

Figure 6 – The 2QCV3Q model and the requirements gathering techniques

Thanks to the information gathered from the meetings with the owner and collaborators, user interviews, and the analysis of "competing" sites, we were able to identify the requirements for every dimension of the 2QCV3Q model that the "No Pain for Children" site must satisfy. In addition, the 2QCV3Q model allowed us to classify all the information gathered in an iterative and incremental way. Basically, as new information became available it was inserted into a table and organised according to the dimension or dimensions it referred to. The version proposed here (see table 2) documents the requirements used to create the first prototype of the site - a requirements or discovery prototype. Those requirements receiving top priority are represented in italics in the table; they generally coincide

with the requirements that could be realised at low cost and by means of volunteer efforts. Other aspects that require greater investment were left to the second phase, after fund-raising.

Table 2. Requirements of the site No Pain for Children for the dimensions of the 2QCV3Q model

DIMENSION	REQUIREMENTS
Identity	*Appropriate logo* *Colours and photos to transmit a positive image* Targeted users: families, professionals
Content	Existence of different sections: • *on the association and on the projects* • *on pain and related therapies* • *on fund-raising* • *for parents* • for professional caregivers Follow the guidelines of "The Health On the Net Code of Conduct" (http://www.hon.ch/Project/HONcode.html) for the quality of medical and health information on the web
Services	Differentiated by user: • parents: on-line guide, forum, guestbook; • professionals: announcements of seminars, courses, conventions, specialisations, bibliography Common services: newsletter, useful telephone numbers, links to related sites
Location	*Intuitive address (containing the name of the association)* *Easily found, thanks to its good positioning on the search engine (clearly defined key words)* *Enable users to interact with the association and its collaborators, with the Webmaster, and with other users (virtual community functionalities)*
Maintanence	*Allow users to comment on the site (form, open letters) and benefit from the most interesting suggestions* *Periodic updates of the information done by designated individuals under the auspices of the association* *Display date of creation and of last update* Complete functionality and correctness Technical/technological maintenance
Usability	*Provide instruments to facilitate navigation* *Employ commonly used hardware and software* Consider needs of the disabled (W3C, use of "Bobby Validator") *Use clear and simple terminology (possibly a glossary)* Provide translation in other languages (at least in English*)*
Feasibility	*Technical Resources:* • *PC connected to Internet* • *space on an ISP (www.register.it)* • *browser (Netscape and IE)* • *environment to develop HTML pages (Front Page)* • *software for graphics files (Paint Shop Pro)* *Human Resources required:* • *a graphic artist*

	• *a designer*
	• *a Webmaster (coinciding with the designer role)*
	• *experts in analgesic therapy*
	• *an expert in text editing (a journalist)*
	• *translators (French, German, Spanish, English)*
	• *front-line experts (at least one)*
	Financial Resources: • *projected budget: from 2,500 to 15,000 Euro annually for management* • *costs incurred to date: near zero*

Based on these requirements, a structure of the content (corresponding to the *Content* and *Services* dimensions of the 2QCV3Q model) of the site was created. It contains five topical sections: the association, paediatric pain, for the parents, for doctors and healthcare professionals, how to help the association. The result is the hierarchical scheme presented in table 3.

The first version of the prototype – it's home page home is presented in figure 7 – was used to integrate and validate the requirements gathered until that point in the project.

When the first prototype was presented to the promoter and other collaborators, they expressed some misgivings about the graphics and layout of the home page, asserting that it did not adequately represent the mission of the association, a criticism repeated by the doctors, families and children. They also objected strongly to the narrow definition of the target of the site, which at that time envisaged two targed users: parents and medical professionals. These initial observers, however, preferred a more general target and also a lessening of the emphasis on the doctor/paramedic user.

Figure 7. Home page of the first prototype of the Web site of the association "No Pain for children"

Besides giving indications for updates to the site requirements, the prototype made it possible to identify potential areas of conflict, in particular those stemming from the demands of families for services that the association on one hand is unable to provide directly while on the other hand it is called on to act as an intermediary with doctors, a possibly complex negotiation, given the sensitivity

of the issues involved. Other conflicts could arise from the need for adequate financing to pay competent medical professionals. For similar reasons, the promoter strongly objected to the presence of two different sections – one for parents and another for medical professionals. Therefore, we were asked to reorganise the sections and to provide a new graphic interface; this resulted in the second prototype (figure 8).
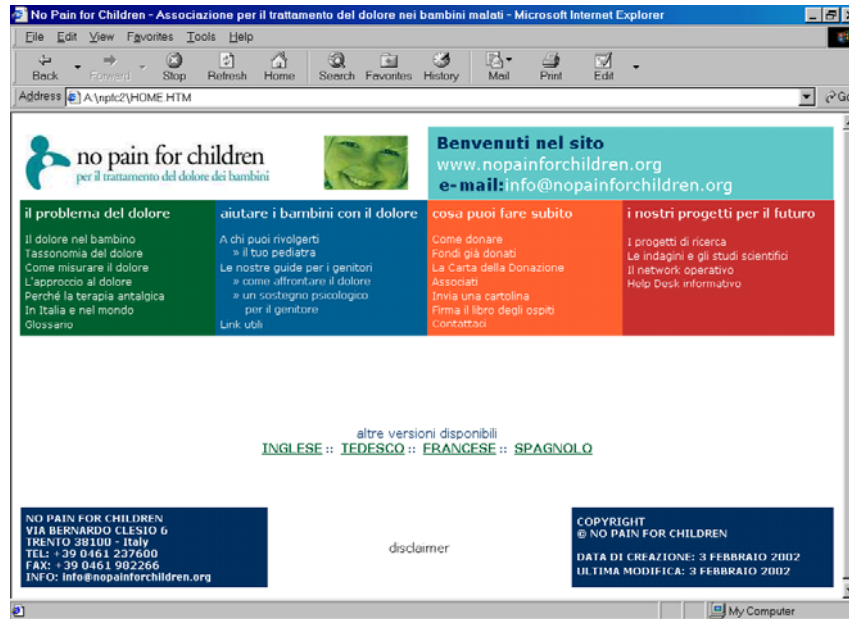

Figure 8. Home page of the second prototype of the Web site of the association "No Pain for Children"

The use of prototypes also made it possible to integrate all the requirements documentation, which had from the beginning been done using tables in natural language that were structured according to the 2QCV3Q model. The prototypes were also used to negotiate, document and validate the requirements for the image of the site (logo and graphic design), a step not to be underestimated given that it is a nonprofit association operating in a sensitive topic area and having stakeholders who approach the site using diverse languages, some highly specialised.

All in all, the use of the 2QCV3Q model together with the prototypes enabled the adoption of a lightweight approach to requirements analysis, which allowed the project team to:

- involve all stakeholders by encouraging them to express their needs in a context that can be classified among those defined as "innovative" products;

- combine the use of diverse techniques for gathering requirements information, limiting the risk of losing valuable information and fostering the exploration of alternative solutions;

- create – while engaging in requirements analysis activities – a common vocabulary so as to provide a glossary for the project;

- categorise the requirements starting from the first iterations, facilitating documentation and management and underlining problems;

- take into account the points of view of all stakeholders and renegotiate by means of a semi-structured informal description any requirements that are conflictual;

- enable also junior analysists to be involved in the analysis, even if lacking substantive experience in the area;

- contain the costs necessary for requirements analysis activities.

Table 3. Architecture of the information.

ASSOCIATION
- WHO WE ARE:
  - our history
  - our logo
  - letter from the president
- THE ORGANISATION
  - description
  - statute
  - balance
  - organs
  - donors
  - Association in Friendship with the Foundation
- SCIENTIFIC COMMITTEE
- SPONSORSHIP
- OUR PLANS FOR THE FUTURE
  - research
  - upcoming events/presentations
PAEDIATRIC PAIN
- WHY ANALGESIC THERAPY
- DIVERSE TYPES OF PAIN
- HOW TO MEASURE PAIN
- HOW TO CONTROL PAIN
- ANALGESIC THERAPY IN ITALY AND IN THE WORLD
- SOME TESTIMONIALS
FOR PARENTS
- WHOM TO CONTACT
  - Paediatrician
  - Centres for analgesic therapy
  - Contact us
  - Meet one of our volunteers
  - Meet with a doctor
- OUR GUIDES
  - How to confront pain in children
  - A psychological support for you
- USEFUL LINKS
- NEWSLETTER
FOR DOCTORS AND HEALTH CARE PROFESSIONALS
- CURRENT STATUS OF RESEARCH
- BIBLIOGRAPHY
- COURSES AND CONFERENCES
- POSSIBILITIES FOR SPECIALISATION
- GUIDELINES FOR OMS
- USEFUL LINKS
- NEWSLETTER
HOW TO HELP THE ASSOCIATION
- HOW TO BECOME A MEMBER
- HOW TO SUPPORT THE ASSOCIATION
  - How to donate
  - Contributions

- FUND RAISING POSTCARDS
- SIGN THE GUESTBOOK AND LEAVE A COMMENT
- WRITE TO US
- NO PAIN FOR CHILDREN IN YOUR CITY
- BECOME A VOLUNTEER

4. Related works

Several authors have dealt with the problems and challenges related to defining Web site requirements. The most frequently cited of these are the increased importance of users and stakeholders in general, a differentiated target audience existing in a context that extends beyond the organisational boundaries, the as yet relatively limited experience with business models for the Web, greater volatility of requirements, greater propension to build too early; a blurring of the boundaries between the phases of the development process, and a shorter life cycle and limited resources (see for example, [13, 23]).

As for research on techniques and tools to support the Web analyst in evaluating requirements, we can see that the energies of researchers are focused principally on the "requirements analysis-design gap" rather than what can be called, by analogy, the "problem- requirements analysis gap". Exceptions are found in the approaches coming from the area of Information Systems, and then adapted to the development of Web sites. Of particular interest among these is the SSM/ICDT (Soft System Methodology/Information Communication Distribution Transaction) approach. Based on a seven stage model, SSM is intended to support initial requirements analysis preceding prototyping [24]; the "strength (of this approach) is an enquiring framework to support an exploration of a problem situation", however this scheme does not cover all the components of a Web site and possibly risks leading to a development process that is too mechanistic [30]. Another research line includes methods that emphasize the analysis of the objectives of the system, blending goal-oriented techniques with scenarios [2], an example being the UWA Requirements model, which model proposes an innovative way to decompose the goals into subgoals and then into requirements. However, its focus is still more on requirements modelling than on requirements elicitation. Better adapted to create a common platform for communication with some stakeholders – those of the business – is the use of "e-business" patterns [1]; however, while constituting a useful tool for sites engaging in e-commerce, these patterns are not applicable to every type of site.

Our proposal to apply a general-purpose, domain-independent model for Web site quality to requirements analysis is meant to costitute a step ahead in defining tools that can effectively manage the activities surrounding requirements analysis from the very first stages of a project. To our knowledge, no other such proposals currently exist. The use of the 2QCV3Q model can be integrated with existing methodologies for Web site development, giving a more structured input for the realisation of models they produce. In fact, we are now experimenting with the application of the 2QCV3Q model combined with scenarios and use cases for the design of Web sites for tourist destinations. At a more general level, experiments are in progress to integrate our approach with the UWE methodology [9] and OOHDM [26]. In addition, results obtained from applying the meta-model 2QCV3Q when re-engineering existing sites [17], further underlined how the model makes it possible to have a level of documentation that is comprehensible for all stakeholders, yet requires relatively little effort to achieve.

5. Conclusions

In this paper we have presented the application of a quality model to analyse the requirements for the Web site of a newly founded nonprofit association. Before then the model had been applied mainly to evaluate the quality of existing sites, but it proved to be useful also in the very initial requirements analysis phase. The case described to illustrate this presents most of the typical problems related to the analysis for a Web site development project. Using the 2QCV3Q model, it was possible to take into account the points of view of all the actors involved in the project. More specifically:

- the model facilitated communication with the owners, providing a conceptual framework and a basic common language;
- in interviews with the different target user groups (families, doctors, paramedics), the model was used to create a questionnaire and also to organise the answers given in the unstructured part of the interview;
- with the model it was possible for the graphic artist to identify from the beginning some clear indications regarding the graphic design of the site.

Moreover, the 2QCV3Q model was used to "analyse the competition" in order to identify "best practices" of sites having similar goals. Of special importance is the fact that it was possible to synthesise all of the information gathered within the seven dimensions of the model, and also to prioritise the information. In general, given the communicative nature of requirements analysis activities, using the model helped make the decision making process more efficient. The model did not eliminate differences, but rather made it possible to more rapidly identify potential areas of conflict, thus helping the analyst to work more efficiently on areas requiring greater and perhaps immediate attention.

As regards the development process, the use of the 2QCV3Q favoured an iterative and incremental approach wherein it was possible to have in a short time specifications for the requirements for development of explorative prototypes. Used to guide requirements identification and specification, it enabled us to document quickly and easily the changes in requirements. We were also able to check again that the 2QCV3Q framework is "user-friendly", in that it is easily understood and applied by junior developers and fosters a broader view of Web site development. These features mean that the model also lends itself to fostering a more defined development process for Web sites and Web applications also in businesses that would otherwise tend to use a more ad hoc approach. A practical example of this is documented in another paper [6] which describes the initial results of a project for the development of a Web site that supports a virtual community of Italian emigrants abroad; the 2QCV3Q model was applied so as to facilitate a "lightweight" approach to the entire development process. Regarding future developments – besides working to study further those aspects that can encourage a wider use of quality models for Web site requirements analysis - we plan to expand the functionality of the software tool designed to evaluate the quality of Web sites [15], so that it also provides support for requirements process activities.

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