

USING QUALITY REQUIREMENTS TO SYSTEMATICALLY DEVELOP A NATIONAL ACCESSIBILITY PORTAL

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Abstract: Web Engineering methodologies, tools and techniques are based on research from four decades of best practices in Software Engineering. Over the past ten years, users with disabilities have entered the market with several initiatives from governments to protect the rights of this market and to make information and services more accessible to them. The Meraka Institute initiated a technological project that will make information more readily available to people with disabilities. This initiative, called the National Accessibility Portal Initiative (NAP), is a multidisciplinary project that uses concepts from Software Engineering and Web Engineering with persons with disabilities as the intended users. Developing a quality web-based application for this market included the identification of the key quality non-functional attributes. In this paper the non-functional requirements for a web-based application for users with disabilities are identified, the development and implementation of the NAP portal is discussed and a description of how the essential non-functional requirements were adhered to in the implementation is provided.

1. INTRODUCTION

According to a survey conducted in October 1995, a disability prevalence of between 5% and 12% is estimated in South Africa (1997). The social and economic upliftment of people with disabilities and their integration into society is a major global challenge that is even more pertinent in developing countries. A universal paradigm shift is currently occurring: disabilities are no longer treated as medical and welfare issues, instead disabilities are addressed within the broader context of the social environment. In response to this challenge, the Meraka Institute¹ embarked upon an initiative to support the disability community, called the NAP Initiative. The NAP Initiative consists of a number of components (see Figure 1), that collaborate to ensure delivery of the objectives to enable people with different disabilities to access information and services over the Internet, to interact and communicate irrespective of age, gender, disability, language or level of literacy (2006). The focus of this paper is on the development of the first component, namely the NAP portal.

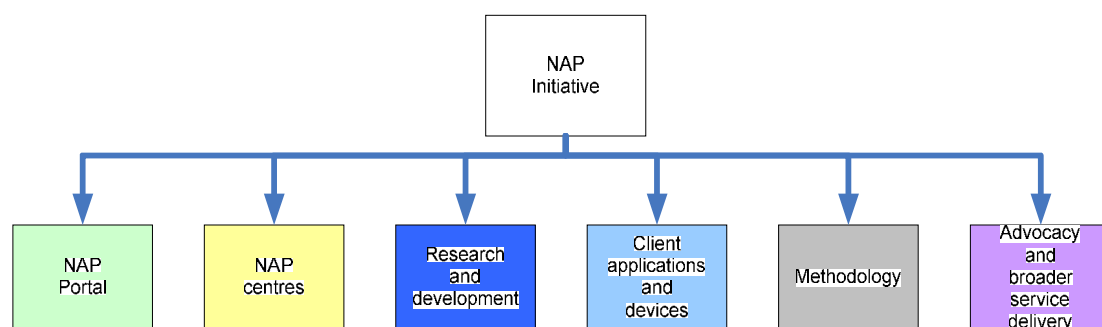


Figure 1: NAP initiative breakdown diagram

In order to perform requirements engineering for business systems, the development team needs to select an appropriate approach from the various established methodologies, tools and techniques (Whitten, Bentley et al., 2000; David and Fitzgerald, 2003). These tools and techniques were developed and tested over a number of years and the requirements engineer selects the most

¹ The Meraka Institute is the African Advanced Institute for Information and Communication Technologies – Managed by the CSIR.

appropriate for his/her specific system. Similarly, numerous techniques, tools and methodologies for the development of *web-based applications* have evolved over the past ten years (Liddle, Mayr et al., 2000; Pressman, 2005). Although a number of publications and initiatives focusing on web-based *accessibility* (WC3, 2006) and *usability* (Johnson, 2000; Nielsen and Loranger, 2006) are available, a limited number of publications on the *development strategies* of web-based applications for people with disabilities are available (Paciello, 2000; Macagnano, 2005).

An important issue pertaining to the development of a *quality* web-based application is the identification of non-functional requirements (Yusop, Zowghi et al., 2006). Functional requirements describe the behaviour (functions or services) of the system that support user goals, tasks or activities, while non-functional requirements refer to the constraints and qualities of the system. Qualities are properties or characteristics of the system that concern the stakeholders and subsequently affect their degree of satisfaction with the system (2001).

As noted previously, there are very few publications in the field of web developing strategies that identify the non-functional requirements for a web-based application. In this paper, the focus is on the identification of non-functional requirements for a web-based application intended for a specialised and important market, namely the user with disabilities. This paper may be classified as a combination of an opinion paper and personal experience paper. The authors have identified a lack of published requirements and extended the ISO 9124 model to include attributes from other publications and requirements retrieved during the requirements analysis for a web-based application.

This paper is presented in four subsections of work. Existing non-functional attributes for the development of quality systems are introduced in section 2.1. This list is supplemented by information obtained from the data-gathering activity (section 2.2). Thereafter a discussion of the web-portal design is presented in section 3 and the implementation in section 4. Section 5 comprises a discussion of the different attributes in relation to adherence by the developed portal.

2. IDENTIFICATION OF THE NON-FUNCTIONAL REQUIREMENTS

Quality characteristics, such as correctness, reliability and maintainability are imperative for the successful delivery of a system (Chung and Nixon, 1995). These characteristics are identified and used during the development process as a method of quality control to reduce risks. In section 2.1 certain characteristics that are used in existing software quality models are discussed, thereafter attention is given to important characteristics for the NAP portal in section 2.2.

2.1 Suggested non-functional requirements

McCall, Richards and Walters (1977) and Boehm (1989) introduced some quality attributes that were used by developers during the development cycle as non-functional requirements. In 1991, the International Standards Organization (ISO) followed with the ISO 9126 Quality Model (ISO, 1991) that lists some non-functional requirements to which a system should adhere.

These models, with the accomplishing attributes, were derived for ordinary systems and were not intended as web-development models. However, Chua and Dyson (2004) used the ISO model (1991) as an evaluation tool for the development of an e-learning system. According to Chua and Dyson, *the ISO model provides a detailed analytical tool and is useful in moving beyond superficial evaluation to achieve a more thorough view of the system's strengths and weaknesses than can be provided by less systematic approaches* (Hyatt and Rosenberg, 1996). The authors stress that there are certain inherent weaknesses in the model with regard to the *usability* characteristics. They suggest the extension of the attributes to include more specific characteristics such as *consistency*, *simplicity*, *legibility* and *colour* use. It is further suggested that a *help* sub-characteristic be included as part of *usability*, in order to ensure that this important factor is not neglected.

Another important characteristic mentioned by Offutt (2002) that is not included in any of the above models, is the *scalability* of web systems. For this requirement, the development team should consider the growth of the system structure (*extensibility*) and the secure growth of web content while maintaining a reputable information repository (*secure growth*). Changes are furthermore allowed in performance or format within a common framework, while retaining partial or complete *compatibility* among systems that belong to the common framework (ATIS, 2006). It should also support a growing number of users that the portal can service (*user growth*).

For the development of the NAP portal, the same route as Hyatt and Rosenberg (1996) was followed and the ISO model (1991) was used as the point of departure. The characteristics mentioned above were also included in order to identify the non-functional requirements that the development team should consider during the development cycle (Table 2).

Table 2: Adapted ISO characteristics list

| Characteristic | Sub-characteristic | Explanation | Important in NAP Portal |
|---------------------|-----------------------|--|-------------------------|
| Functionality | Suitability | Can software perform the tasks required? | Yes |
| | Accuracy | Is the result as expected? | Yes |
| | Interoperability | Can the system interact with another system? | No |
| | Security | Does the software prevent unauthorised access? | Yes |
| Reliability | Maturity | Have most of the faults in the software been eliminated over time? | Yes |
| | Fault tolerance | Is the software capable of handling errors? | Yes |
| | Recoverability | Can the software resume working and restore lost data after failure? | Yes |
| Usability | Understandability | Does the user comprehend how to use the system easily? | Yes |
| | Learnability | Can the user learn to use the system easily? | Yes |
| | Operability | Can the user use the system without much effort? | Yes |
| | Attractiveness | Does the interface look good? | Yes |
| | Consistency | Are the pages constructed consistently so that they form a unit? | Yes |
| | Simplicity | Are the web pages easy to use and self-explanatory? | Yes |
| | Legibility | Is the font size used acceptable? | Yes |
| | Colour use | Is the colour use in accordance with usability principles? | Yes |
| | Help functions | Does the system provide assistance? | Yes |
| Efficiency | Accessibility | Is the system accessible and usable to users with disabilities? | Yes |
| | Time Behaviour | How quickly does the system respond? | Yes |
| Maintainability | Resource Utilisation | Does the system utilise resources efficiently? | Yes |
| | Analysability | Can faults be easily diagnosed? | Yes |
| | Changeability | Can the software be easily modified? | Yes |
| | Stability | Can the software continue functioning if changes are made? | Yes |
| Portability | Testability | Can the software be tested easily? | Yes |
| | Adaptability | Can the software be moved to other environments? | No |
| | Installability | Can the software be installed easily? | No |
| | Conformance | Does the software comply with portability standards? | No |
| All characteristics | Replaceability | Can the software easily replace other software? | No |
| | Compliance | Does the software comply with laws or regulations? | Yes |
| Scalability | Extensibility | Can the system grow in content and structure without technical intervention? | Yes |
| | Secure growth | Does the system allow the content to grow while preserving the integrity of the content store? | Yes |
| | User growth | How many users can the application service? | Yes |
| Localisation | Language adaptability | Does the system support multiple languages? | Yes |

2.2 Data gathering in establishing the requirements for the NAP system

During requirements engineering, the identification of the user needs and the formalisation of requirements are some of the important activities conducted by system developers (Sun and

Ousmanou, 2006). In order to establish the non-functional requirements for the NAP portal, the following data-gathering techniques were used:

- A literature review was conducted on disability theory and practice in South Africa and internationally. The secondary research concentrated on the role players, the issues in the field as well as current interventions aimed at addressing the challenges in the disability domain.
- Site visits were made to a number of disability-related institutions such as DPOs (Disabled Persons Organisations), schools, colleges, universities, etc. During the site visits, observations were made and interviews were conducted to document and understand the situation and the current needs of the institutions and their members.
- A number of DPOs were included as part of the project team. This enabled the technical team to interact freely with experts in the domain and to identify the underlying needs and realities when living with a disability. Various methods were investigated with regard to the use of ICT to enable service providers to more effectively provide services to the disabled community.
- The project team also conducted a number of workshops with stakeholders in one of the rural provinces in South Africa to understand the unique needs that exist for persons with disabilities in their environment. The delegates at the workshops included representatives from provincial government departments, local schools, colleges and universities, and other local service providers. In addition to general workshops on the landscape of disability in the province, the provincial department of education became one of the partners in the project and a number of workshops were conducted that focused on education and in particular the need for ICT to support the inclusive education initiative.
- The project established a number of mailing lists focused on specific areas (i.e. disability in general, hearing disabilities, visual disabilities and physical disabilities). The mailing lists are not accessible to the general public; only people active in the field were invited to join. The lists are not currently moderated.

From the data-gathering activities it was possible to establish the non-functional requirements for the NAP portal. The requirements were listed and the list of characteristics in section 2.1 was used as a check-list to ensure that all the non-functional requirements for the system were identified. Two additional non-functional requirements, excluded from the list, were the requirement that the portal must be *multi-lingually adaptable* and that it must be *accessible*. These were added to the list².

In the last column of Table 2, an indication of the importance of each characteristic within the NAP portal is provided. Most of the characteristics listed previously are important as quality characteristics in the NAP portal. It is, however, not essential for the current system that the *interoperability, installability, conformance and replaceability* characteristics are complied with.

Although all the requirements in the list are important, it was concluded from the data-gathering activity that four characteristics that require special attention during the development of a web-based application for people with disabilities, and especially the NAP portal. These characteristics include:

- Scalability (extensibility, secure growth and user growth)
- Language adaptability
- Accessibility
- Usability.

3. THE NAP PORTAL DESIGN

The NAP portal is a web-based content management platform that aims to provide a participatory information repository for content and communication services relevant to disability. The portal was

² The attributes added to the ISO quality model were compiled according to the development team's experience. The authors do not claim that it is a comprehensive list of all non-functional requirements; this may be a topic for future research.

structured to present information pertaining to a number of services, divided into relevant topics, which in turn are logically grouped. The structure of the portal is not static and will grow as new services and topics are identified. The content of the portal will be contributed by members of the user community. Anyone can submit content for approval to be included in the portal. The approval of submitted content will be handled by individuals who are responsible for the quality and relevance of the content in a particular service, topic or group. In addition to content, the portal will also include specific interactive applications that will be developed based on identified needs. The NAP portal will be available on the Internet for access by clients with disabilities (2006).

The portal provides functionality with regard to *User Management*, *Content Management* and *Communication* (see Figure 2). A NAP user or NAP administrator can access the NAP portal. The user will have access through the *NAP view area* and the NAP administrator through the *administration area*. The NAP view and NAP administration areas are described, according to the NAP initiative documentation (2006) in sections 3.1 and 3.2.

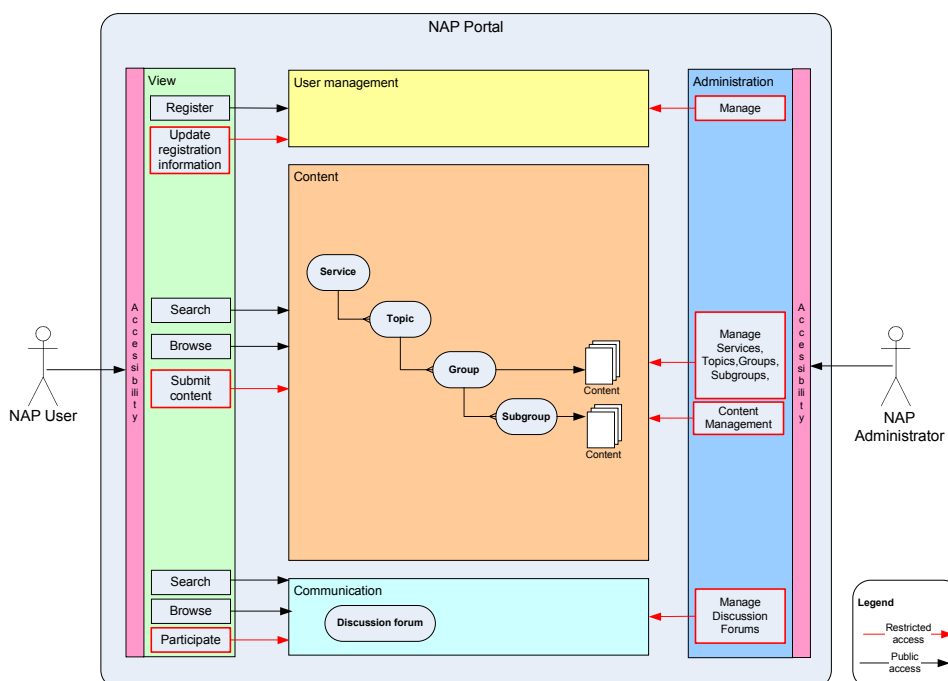


Figure 2: NAP portal (2006)

3.1 NAP view area

The view area of the portal will allow all users to browse through the content available, search for content, view the content, view discussions in the discussion forums and give feedback on the portal and its content. The functionalities mentioned above will be available to all users, registered and unregistered. For certain additional functionalities a user will be required to log in by supplying a valid user name and password. If the user does not have a valid user name and password, he/she will be able to register by supplying personal information. After successful registration, the user will be able to log into the portal.

When successfully logged in, a user will be able to participate in discussions on the discussion forums and submit content to be included in the portal. Submitted content may be new content under a specific service and topic or a new version of content already approved and available on the portal. Alternately submitted content may be a translation, into one of the official languages, of content already approved and available on the portal. A logged-in user will also be able to change his/her registration detail and password at any time.

In order to enhance the accessibility of the portal, a user is able to change the text size as well as the colour contrast of the interface at any time. The portal will be available in all the South African

official languages. A user will be able to select a language of preference on the portal. When the language of preference is selected, the NAP portal interface will be translated into the selected language. All content that is available in the selected language will be shown in that language while content not available in the selected language will be shown in English. The portal will always indicate if a specific content entry is available in another language, irrespective of the selected language of preference.

3.2 NAP administration area

The aim of the administration area of the NAP portal is to enable users to configure and maintain the structure and content of the portal. The administration area is a secure area and the functionalities available under it will not be available to any user unless they are explicitly assigned permission. In order to configure and maintain the structure of the NAP portal, users will be able to maintain the services, the topics under each service, as well as the groups and subgroups defined under each topic. For specific services and topics, a user may be assigned to accept responsibility for the content available under that structure. When content is submitted for inclusion in the viewing environment, it will be routed to the appropriate responsible user who will be able to view the submitted content and decide either to accept or decline it. Accepted content will be available for viewing in the view area.

The NAP portal is intended to always have a communication service with discussion forums as a topic. The discussion forums available under this topic will be maintained in the administration area. Maintenance of discussion forums currently includes the creation of discussion forums as well as the deactivation and reactivation of existing discussion forums.

The development of the NAP portal is conducted in an iterative and incremental manner, which implies that the functionality of the portal will grow and change as newer versions are developed and deployed.

4. IMPLEMENTATION

A temporary prototype of the NAP portal was first developed in 2003. The prototype was used as a proof of the concept and to demonstrate its possible impact. The prototype was tested against members of the user community and stakeholders. Feedback and learning gained from the prototype were incorporated into the first version of the portal. The first version of the portal was deployed in 2006 and available to the NAP consortium members for evaluation and pre-population (Figure 3 – entry screen). The portal will be available to the public immediately after the NAP consortium has completed the pre-population phase.

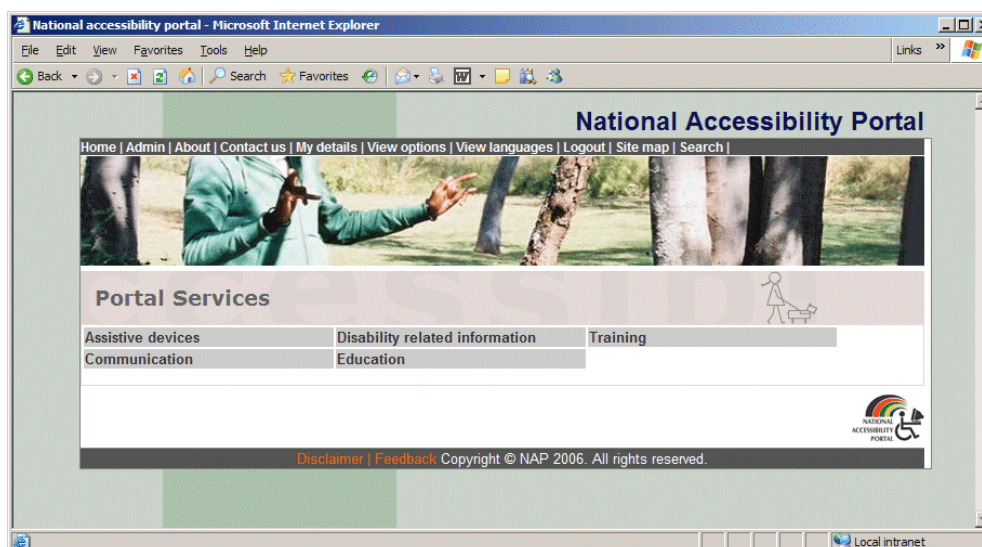


Figure 3: NAP portal entry screen

The portal has been implemented in the following open source technology: A PostgreSQL persistence store with a JBoss application server containing EJB3 entity beans and session beans. The presentation layer is implemented with JSF (Java Server Faces) and facelets with SEAM providing the glue between the EJB3 beans and the presentation. The portal was tested using an automated testing environment for web applications (Canoo), an application testing the accessibility of the software (Bobby) and human testing regimes based on approved test cases.

During the pre-population phase, the portal will be formally evaluated for usability in a usability laboratory. The suitability of the portal will also be evaluated to identify additional requirements. The results of the usability and suitability evaluations will be used as input into the definition of subsequent versions.

5. ADHERENCE TO THE NON-FUNCTIONAL REQUIREMENTS

Section 2 provided a brief overview of the important non-functional requirements for the NAP portal. In this section, a summary of how the non-functional requirements listed in Table 2 were adhered to is presented. Thereafter, section 5.2 presents a detailed discussion of the essential requirements namely *extensibility*, *secure growth*, *language adaptability*, *accessibility* and *usability*.

5.1 Discussion: conformance to non-functional requirements

The quality of a system does not only depend on the functional, performance and interface requirements, it also depends on the non-functional requirements such as reliability, maintainability and correctness (Hyatt and Rosenberg, 1996). Based on the review of relevant literature and the findings of the primary data-gathering activity, a list of non-functional requirements the NAP portal should adhere to, have been identified. These requirements were used as guidelines during the development and implementation of the portal. Table 3 presents a summary of adherence to the requirements.

Table 3: Adherence to the requirements

| Characteristic | Sub-characteristic | Adhere to? | Comment |
|----------------|--------------------|------------|--|
| Functionality | Suitability | √ | The portal was designed to perform the tasks of information management, information dissemination and communication. |
| | Accuracy | √ | The accuracy of the portal will be evaluated and the results will feed into the requirements of subsequent versions. |
| | Security | √ | The portal prevents unauthorised access to secure functionality by implementing a role-based access mechanism. |
| Reliability | Maturity | √ | The first version of the portal has just been deployed. The maturity of the functionality implemented in this version will increase over time. New functionality will be added that will need to mature in its own time. |
| | Fault tolerance | √ | Errors are prevented through validation and reported on detection. |
| | Recoverability | √ | The portal content is stored in a database with a secure backup and recovery plan. |

| | | | |
|-----------------|----------------------|---|--|
| Usability | Understandability | √ | The portal has been designed to be intuitive and users should be able to use the general functionality of the system with prior training. |
| | Learnability | √ | Users will be able to use specialised administration functionality with no more than 1 day of training. |
| | Operability | √ | Tasks are easily performed. The navigation through the portal structure is intuitive and users always know where they are and can navigate further or change direction from any page. The use of breadcrumb links on pages adds to the user control and freedom, and lessens the burden on the memory of the user. |
| | Attractiveness | √ | The user interfaces were designed to be simple and uncluttered, with adequate use of white space. The graphics used are soft and reflect a human element. |
| | Consistency | √ | Page layout, placement of elements on the pages and navigation through the portal is implemented consistently throughout the system to form a unit. |
| | Simplicity | √ | The pages in the portal are easy to use and self-explanatory. |
| | Legibility | √ | The portal includes functionality that enables users to increase the font size of text on the pages to suit their individual needs. |
| | Colour use | √ | The portal includes functionality that enables users to change the colour contrast used on the pages to suit their individual needs. Colour contrast options available include black on white, white on black and yellow on blue. This is especially needed by users with visual impairments. |
| | Help functions | X | User manuals, frequently asked questions and tips on how to access the portal with assistive devices and more will be loaded as content on the portal. Online help is currently not implemented. |
| | Accessibility | √ | The portal has been designed and implemented in accordance with the W3C accessibility guidelines. |
| Efficiency | Time Behaviour | √ | The response of web-based systems is dependant on external factors such as bandwidth, service providers and networking. The system has been designed to respond in less than 5 seconds under optimal conditions. |
| | Resource Utilisation | X | The resource utilisation of the system will be evaluated after implementation. |
| Maintainability | Analysability | √ | The portal is implemented with technology that provides the facility to specify different levels of logging. Errors are logged in log files to aid in fault diagnosis. |
| | Changeability | √ | The design of the portal has a high level of abstraction and modularity that enables changes to the portal to be implemented easily. |
| | Stability | √ | Due to the modularity of the design, the portal will be able to function during the implementation of changes. |
| | Testability | √ | The integrity of the portal was tested using Canoo, an automated testing environment for web applications. Functional testing is performed based on approved test cases. |
| Portability | Adaptability | √ | The ability for the portal to be moved to other environments was not a requirement. However, the technology that was used is portable between environments. |

Table 3 (continued): Adherence to the requirements

| Characteristic | Sub-characteristic | Adhere to? | Comment |
|---------------------|-----------------------|------------|--|
| All characteristics | Compliance | √ | The portal complies with the Access to Information Act. |
| Scalability | Extensibility | √ | The portal was designed to be able to grow as the requirements for information in the field of disability grow, without technical intervention. The portal structure can be adjusted by creating new services, topics, groups and discussion forums without any additional software development. |
| | Secure growth | √ | The portal allows the user community to submit content for inclusion in the portal. All submitted content is subjected to an approval process before it is available for viewing in the portal. |
| | User growth | √ | The portal will be able to accommodate a growing user base without deterioration in performance. |
| Localisation | Language adaptability | √ | The portal has been designed to support all 11 official languages of South Africa. Users are able to specify their language of choice that will result in the portal interface and content to be shown in the chosen language. |

The NAP portal adhered to most of the sub-characteristics that were identified as important in section 2.1. In terms of *functionality*, the *accuracy* will be continuously evaluated in order to enhance future versions of the portal. The *security* characteristic was covered by implementing a role-based access mechanism, and thereby preventing unauthorised access.

In terms of the *reliability* requirement, the development team enforced *fault tolerance* through the validation of any input values and a report mechanism as soon as an error fault is detected. A secure backup and recovery plan ensure that it is possible to *recover* from a failure.

Usability is one of the most important characteristics of the portal. Most of the sub-characteristics in this category are adhered to, except for the *Help function*, which is currently only supported through user manuals, frequently asked questions (FAQ) and tips on how to access the portal with assistive devices. The *accessibility* of the system is discussed in the following section.

Within *efficiency*, it was not possible to evaluate the *resource utilisation*. This attribute will be evaluated after implementation. For both *maintainability* and *compliance* the NAP portal adhered to all the characteristics. *Scalability* and *localisation (language adaptability)* are the remaining characteristics that were identified as essential requirements and are discussed in further detail in section 5.2.

5.2 Discussion: conformance to essential requirements

As discussed in section 2, *extensibility*, *secure growth*, *language adaptability*, *accessibility* and *usability* are essential requirements in the NAP portal. An overview of these characteristics is presented in order to illustrate how the requirements were met in the NAP portal system.

5.2.1 Scalability: extensibility

The aim of the NAP portal is to provide an extensible content repository that will grow as the requirements for information in the disability domain grow. This implies that the portal must adjust to additional requirements without the need for technical intervention. In order to accommodate this, the portal is designed to adjust to the content structure at any stage without requiring additional software development. This growth is accomplished through the use of services, topics and one or more levels of groups (Figure 2).

Services are the highest level grouping of related content. A user with the required privileges assigned to him/her is able to maintain the services available in the portal at any time. The

maintenance of services includes the creation of services, updates to existing service names and the removal of existing services.

Each service contains a number of *topics*. Topics are sub groupings within a specific service. The allowable format of the content that can be captured under a specific topic is specified on this level. A topic may contain content in one or more of the following formats: paragraphs of text, URL to relevant websites, documents, images, video clips, audio clips and contact information. This enables the person defining the topic to dictate the format in which the content must be loaded and presented under the topic.

Each topic contains one or more levels of *groups*. The group levels form a tree structure of groups and subgroups that provide the final context of the content in the portal under a topic. It is important to note that content may only be linked to the lowest levels of the group structure.

In the communication service, *discussion forums* may be maintained to adjust to the growing need for different discussion forums. Maintenance of discussion forums includes the creation of new forums, updating of existing forums and the deactivation of existing discussion forums.

The ability to add, edit and delete services, topics, groups and discussion forums on the fly, without any technical intervention makes the portal very easily *extensible*.

5.2.2 Scalability: secure growth

The aim of NAP is to provide a participatory information repository that enables members of the disability community to contribute relevant content to be included in the portal. The portal provides any visitor to the portal with the opportunity to submit content they feel is relevant and should be included. The purpose of this functionality is to enable the user community to take ownership of the portal and the information available within. When a user elects to submit new content, he/she will be required to register and log in. This is to ensure that the person(s) responsible for content can follow up with the source of the content if necessary.

When a user submits new content for inclusion, he/she will be guided through the capturing process by a wizard. The wizard will request the compulsory information regarding the content and require the user to indicate the relevance of the content in terms of disabilities, geographic location and interest groups. The relevance of the content will be used for advanced searching and to filter the portal based on user profiles planned for a later version. The wizard will request the rest of the information of the content based on the content format that was specified when the relevant topic was defined.

When a registered user submits content, it is forwarded to the content manager assigned to the topic for which the content was submitted. A content manager is a person in the user community who accepts responsibility for ensuring the relevance and quality of the content under a specific topic. A content manager will be able to view and edit content submitted and approve or decline the content. If the content is approved, it will be available for viewing in the portal. If the content was declined, the submitter will be notified via e-mail with a reason for the content being declined.

Existing, approved content in the portal can only be edited by the content manager of a specific topic, or the user who originally submitted the content for inclusion. When the original source of the content edits the approved version, the new updated version will be routed to the content manager for approval before being made available for viewing.

The functionality provided by the NAP portal that enables users to submit content to be included in the portal ensures the independent growth of the portal, while the functionality to enable content

managers to approve or decline submitted content ensures that the growth remains controlled and content quality remains of an acceptable standard.

5.2.3 Language adaptability

One of the strategic directives for the NAP portal was that it should be available in all eleven of the South African official languages. The aim is to bring relevant information to people with disabilities in rural areas where their knowledge of English is limited or non-existent. The portal has been designed to enable a user to specify the language of his/her choice. This can be done while browsing the portal or when the user registers. After a language has been chosen, the portal interface is displayed in the selected language.

Automatic translation technology for South African languages is at present not a functional reality. This implies that information on the portal cannot be automatically translated into the other official languages. To address this limitation, the services of human translators were used to translate all the phrases and words displayed in the portal interface.

Figure 4 shows the portal when 'seSotho sa Leboa' was chosen as the preferred language.

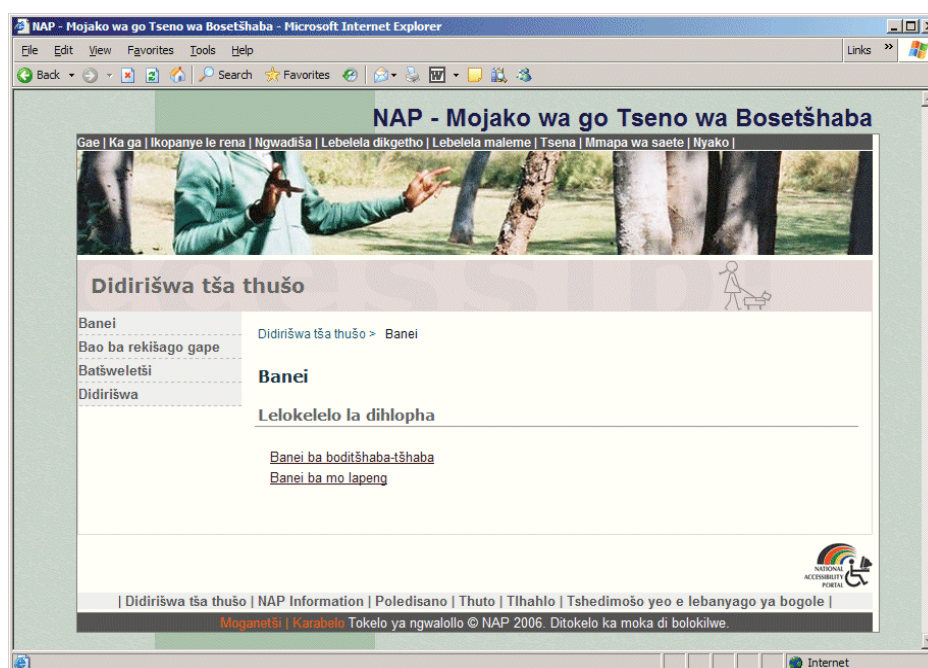


Figure 4: Multilingual support

The translation of the content in the portal presented a considerable challenge. The content submitted for inclusion in the portal is initially submitted in one language. The user who submits the content cannot be held responsible for translating the content into all eleven languages. Similarly, the NAP project cannot take responsibility for translating all the content submitted for inclusion in the other official languages.

The designers adopted the approach of making English the reference language for all content. This is therefore implied that new content submissions must be made in English. Subsequent to approval of the English version, any user may submit a translated version of the approved content in another official language. The submitted translated version is routed to the content manager in the same manner that new content is routed to him/her for approval. The content manager is responsible for ensuring that the submitted version is an accurate translation of the approved English version. The services of human translators will be used in this regards. Subsequent to verification of the translation, the content manager will approve or decline the submitted translation.

When a language other than English is selected as the language of preference by a user, the complete portal interface is displayed in the selected language. The content that is available in the selected language will be displayed in that language, while content that is not available in the selected language will be displayed in English.

5.2.4 Accessibility

Since the portal was specifically designed for use by persons with disabilities, accessibility was the most important requirement of the NAP portal. The portal has been designed and implemented in accordance with the W3C accessibility guidelines in order to make it accessible to most of the available assistive devices. In addition, functionality was added that can enable users to customise the display of the portal to suit individual needs. The purpose of the adjustable display is to enhance the accessibility of the portal for people without access to an assistive device.

The display preferences can be specified at any time during the use of the portal, or when the user registers. The specified options will be stored and the portal will display the selected display options when the user returns to the portal.

Currently the display options only address font size and colour contrast. The text size gives the user a choice of three text sizes, while the colour contrast gives a choice between black on white, white on black and yellow on blue.

5.2.5 Usability

The NAP portal is aimed at users with limited computer literacy. Usability is therefore an important design priority. The portal has been designed according to heuristic principles. The user interfaces have been designed to be simple and uncluttered, with adequate use of blank space. Navigation through the portal structure is intuitive and users always know where they are and can navigate further or change direction from any page. The use of breadcrumb links on pages adds to the user control and freedom, and alleviates the burden on user memory. Errors are prevented through validation of all input values and errors are instantly reported on detection. Page layout and navigation is consistently implemented throughout the system.

In addition to the user interface design, functionality has been included to enhance usability. A search facility has been included to enable a user to search the portal for information based on words or phrases. A site map has been included that provides users with a bird's eye view of the complete structure of the portal and provides easy navigation to any area within the portal.

6. CONCLUSION

The Meraka Institute is privileged to have the necessary support to be involved in development activities for the disability community. Persons with disabilities account for a large proportion of the population with limited access to technological enhancements. The development of the NAP portal is an initiative that supports the Integrated National Disability Strategy (1997) and represents a step forward for persons with disabilities, enabling access to information and communication facilities that were previously difficult for them to obtain.

Development of the NAP portal involved a multi-disciplinary approach that incorporated traditional *system design* concepts, *web engineering strategies* and *disability* aspects. Although material was available separately for the elements, a limited number of publications were available for the combination of the three elements. In developing the portal, the development team therefore followed a development research approach where existing theory was used and complemented by non-functional requirements essential for the disability application domain.

In this paper, the authors presented an overview of the existing non-functional requirements identified in the ISO 9126 quality model and used these requirements in conjunction with requirements derived from other authors and from the data-gathering activities. These requirements were used as a guideline during the development of the portal. *Extensibility, secure growth, language adaptability, accessibility* and *usability* were identified as essential requirements. The NAP portal adhered to these requirements and there is therefore strong evidence that the portal has the potential to qualify as a quality national accessibility portal.

In the near future, the authors intend to investigate unique requirements engineering techniques and tools appropriate for functional, usable web-based applications for persons with disabilities.

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